NHB 1700.1 (V1-B)
JUNE 1993

NASA SAFETY POLICY AND REQUIREMENTS DOCUMENT

National Aeronautics and Space Administration
Washington, DC 20546

NASA SAFETY POLICY AND REQUIREMENTS DOCUMENT

PREFACE

EFFECTIVE DATE: June 1993
*** EFFECTIVE PERIOD: 18 Months**

The NASA Safety Policy and Requirements Document (formerly called the Basic Safety Manual) is the central Agency document containing policy and safety requirements and guidelines that define the NASA Safety Program. It is a living document subject to continuous upgrading and change. This document serves as a general framework to structure the more specific and detailed requirements for Headquarters, Program, and Field Installation Directors.

This is primarily a safety document and is not meant to provide direction to Occupational Health personnel or to assume responsibility for occupational health activities; however, some health references are included to assist Field Installation safety personnel in interactions with the health program. Primary Occupational Health and Safety requirements are specified in NHB 2710.1, "Safety and Health Handbook — Occupational Safety and Health Programs."

Additional safety publications, based on this document, have been and will be developed and issued to convey instructions that either are too detailed for inclusion in this document or require special distribution.

The policies of this document apply: (1) to all NASA organizations, elements, entities, or individuals; (2) to all contractor personnel involved in operations at NASA facilities; (3) to all NASA equipment, property, systems, and facilities; and (4) during all phases of the life cycle of systems or facilities.

This document is not a direct instruction to NASA contractors, but provides guidance to the responsible NASA contracting officer. For contractors, it is applicable (as appropriate) through contract clauses in conformance with the NASA Federal Acquisition Regulation (FAR) Supplement. It applies to the Jet Propulsion Laboratory (JPL) as directed by NMI 1410.3, "Application of the NASA Management Directives System to the Jet Propulsion Laboratory." Non-NASA, non-contractor personnel will follow the provisions of this document when on NASA property. This document shall not supersede more stringent requirements imposed by individual NASA organizations and other Federal, State, or local government agencies.

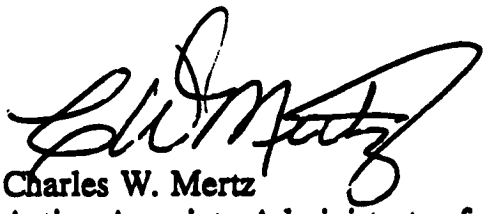
This document is issued in looseleaf form and will be revised by change pages to maintain currency.

---

* By agreement reached during the final staffing process, this policy document will be reviewed within 18 months for impact and currency. After 18 months (December 1994), this document will be either extended, revised, or canceled.

Comments or suggestions concerning the application of these requirements to specific projects should be referred to the National Aeronautics and Space Administration Headquarters, Director, Safety and Risk Management Division, Office of Safety and Mission Assurance, Washington, DC 20546.

This document cancels NHB 1700.1(V1-A), dated January 17, 1983, and Change 1, dated April 11, 1988, and supersedes NHB 1700.1(V3), dated March 6, 1970.



Charles W. Mertz
Acting Associate Administrator for
Safety and Mission Assurance

DISTRIBUTION:
SDL 1 (SIQ)

RECORD OF CHANGES

Change No.	Date	Title or Brief Description	Entered By	Date Entered

This page intentionally left blank.

TABLE OF CONTENTS

CHAPTER 10: MISHAP REPORTING, RECORDKEEPING, AND INVESTIGATING

APPENDICES

LIST OF FIGURES

This page intentionally left blank.

CHAPTER 1: BASIC SAFETY MANAGEMENT

100 GENERAL

a. This document establishes the policies, requirements, and guidelines that define the NASA Safety Program. Safety compliance is a responsibility vested with senior management and executed by the immediate task supervisor. All employees are responsible for their own safety, as well as that of others whom their actions may affect.

b. The effectiveness of NASA's safety program is dependent on the same criteria that result in successful completion of any program:

(1) Management's desire to accomplish program objectives in a safe manner.

(2) Employees' dedication to perform their assigned responsibilities in a safe and prudent manner.

c. In general, a safety program's success or lack of success can be measured objectively by the number of close calls or incidents involving injury or death to personnel, and loss or damage to property. These often result in personal and family tragedy, a loss of mission to the Agency, increased capital replacement costs, operational delays, lost productivity, short- and long-term financial costs to the Agency, medical expenses, or any combination of these. It must be recognized that NASA is involved in many activities with a high potential risk. Risk evaluation/acceptance is one of NASA's most challenging activities and is an integral part of NASA's safety program. (See paragraph 108, Risk Assessment.)

d. A comprehensive configuration control program is a key part of NASA's safety program. Up-to-date configuration control shall be maintained on equipment and systems. An independent assessment of all systems shall be performed prior to changes that might increase the hazard to personnel or equipment.

101 REFERENCES

A list of documentation referenced throughout this document is located in Appendix A.

102 BASIC POLICY

The policy for the NASA Safety Program is provided in NMI 8710.2, "NASA Safety and Health Program," and in this document. For specific health program requirements, see NMI 1800.4, "NASA Occupational Health Program." NASA's fundamental safety policy is to:

a. Prevent:

(1) Loss of life.

(2) Personnel injury.

(3) Equipment or property damage or loss.

(4) Mission or test failures.

(5) Events that could cause adverse public reaction.

b. Use an organized and systematic approach to identify and control hazards (including residual risks), ensuring that safety factors are fully considered from conception to completion of all Agency activities.

c. Use a systematic approach to measure the safety risks associated with all hazards and provide this risk assessment to program management.

d. Promote safety by instilling safety awareness in all NASA employees and contractors.

e. Support and maintain a well-defined safety program and organization. Safety will be accomplished as a line organization function, as an integral part of each director, manager and supervisor's responsibilities and included as part of their performance appraisal criteria, with timely monitoring, surveillance, and support from the professional safety staffs.

f. Eliminate or control hazards by corrective action with the following priorities:

(1) Eliminate hazards by design.

(2) Minimize or negate the effects of hazards by design.

(3) Install safety devices.

(4) Install caution and warning devices.

(5) Develop administrative controls, including special procedures.

* (6) Provide protective clothing and equipment.

g. Provide for cognizant NASA safety personnel access to all NASA operations (including appropriate security clearances) unless there are specified compelling reasons for access denial.

h. Authorize cognizant safety personnel to terminate operations (Red Tag authority) that represent clear, present, and unwarranted danger to employees including contractor employees and the public. Such operations shall not be resumed until such conditions or procedures are abated or controlled to acceptable risk levels.

* i. Encourage employees to report suspected unsafe or unhealthful conditions promptly to their supervisors for immediate action. Provisions shall be made to allow employees to submit hazard reports anonymously if they so desire. If the conditions represent imminent danger to personnel or property or are not corrected to the employees' satisfaction, Installation safety or health officials shall be notified. The unsafe or unhealthful conditions will be documented using a hazard report form that contains all elements as shown in Appendix B.

j. Provide assurance that no employee is subject to restraint, interference, coercion, discrimination, or reprisal for filing a report of an unsafe or unhealthful working condition, or other participation in NASA's Occupational Safety and Health Program activities in accordance with 29 Code of Federal Regulations (CFR) 1960, "Basic Program Elements for Federal Employee OSH Programs and Related Matters — Department of Labor" (Subpart G — Allegations of Reprisal). These rights include, but are not limited to, the right of employees to decline to perform their assigned tasks because of a reasonable belief that (1) the tasks pose an imminent risk of death or serious bodily harm and (2) there is insufficient time to seek effective redress through normal hazard reporting and abatement procedures provided in NHB 2710.1, "Safety and Health Handbook — Occupational Safety and Health Programs."

k. Provide for Safety review and approval/disapproval of all waivers and deviations to safety requirements. See paragraph 121 for specific requirements on safety management levels of review and approval or disapproval for selected safety requirements.

* Joint Safety and Health responsibility.

103 APPLICABILITY AND SCOPE

a. This document applies to all:

(1) NASA organizations, elements, entities, or individuals (including NASA Headquarters when considered a Field Installation).

(2) Contractor personnel involved in NASA operations as specified by contract.

(3) NASA equipment, property, systems, and facilities during their life cycle.

(4) Persons on NASA property.

b. For contractors, it is applicable through contract clauses in conformance with the NHB 5100.4, "Federal Acquisition Regulation Supplement (NASA/FAR Supplement)," Part 1, Subpart 52 and Part 14, Subpart 6 (see Chapter 2). It applies to the Jet Propulsion Laboratory (JPL) as directed by NMI 1410.3, "Application of the NASA Management Directives System to the Jet Propulsion Laboratory." Non-NASA, non-contractor personnel will follow the provisions of this document when on NASA property. This document shall not supersede more stringent requirements imposed by individual NASA organizations and other government agencies.

104 OBJECTIVES

The objectives of NASA's Safety Program are to positively affect the overall success rate of missions and operations and to prevent injury to personnel and loss of property and/or technical reputation. Mandatory program elements include:

a. Providing an aggressive, centralized, and independent safety function for NASA to ensure that its programs/projects are accomplished safely.

b. Providing the necessary planning, direction, development of requirements/policies/methodology/procedures, implementation, and evaluation of the safety program to ensure its goals are achieved effectively and efficiently.

c. Providing the necessary technical reviews of the safety aspects of all development efforts and operations to ensure that they are being conducted in accordance with sound safety engineering principles.

d. Promoting an environment in which all hazardous safety conditions are investigated, and close-call and lessons-learned situations are promptly

publicized, as an accident-prevention, continuous improvement effort, without retribution to the employees.

e. Performing safety oversight functions to ensure compliance with NASA safety policies and assess the effectiveness of NASA safety activities.

f. Establishing and maintaining a NASA-wide workforce of qualified safety professionals who are dedicated to superior performance and the pursuit of excellence.

g. Creating a national focal point for new or unique safety functions and technologies by promoting safety research and development.

h. Complying with the safety standards issued by Occupational Safety and Health Administration (OSHA) in Section 6 of Public Law (PL) 91-596 (the Occupational Safety and Health Act). While these standards are used as the basis for the Safety program, NASA has developed additional requirements to meet the challenges of mission environments.

i. Providing assessments of both qualitative and quantitative safety risks to program management along with recommendations to either accept the risks or request alternative programmatic actions.

105 AUTHORITY AND RESPONSIBILITY

The NASA Administrator is the senior person responsible for Agencywide safety. The Administrator has named, in writing, a Designated Agency Safety and Health Official (DASHO) to serve as the coordinator of the Occupational Safety and Health Programs (see NMI 8710.2). The authority and responsibility for safety policy and oversight are vested in the NASA Headquarters Safety and Risk Management Division (Code QS) within the Office of Safety and Mission Assurance (SMA). Final authority and responsibility for safety at a Field Installation rest with the Field Installation Director. The Field Installation Director will designate, in writing, an Installation safety official who will be responsible for providing safety oversight of the Installation safety activities, ensuring the safety of all Installation operations/programs, and implementing the safety provisions of this document.

106 IMPLEMENTATION REQUIREMENTS

a. General.

(1) The NASA Safety Program will be proactive rather than reactive. Of paramount importance are safety preplanning and mishap prevention, in addition to any required corrective actions. Emphasis is to be placed on adequate safety control, both in-house and in

contractor operations. Constant improvement is to be sought in the overall management of safety. Management interest and involvement must be evident at all levels of the organization.

(2) Managers and supervisors at every level within NASA are responsible for reviewing their operations to identify hazards or unsafe situations and practices, and are accountable for ensuring safety within operations under their supervision. Management followup techniques will be assessed.

(3) All NASA personnel shall act responsibly in matters of safety and require contractors under their purview to conduct their activities in a safe and responsible manner. Strong safety relationships will be developed at all levels. Close working relationships both internally and with contractors will be developed.

(4) Particular attention shall be directed toward interface situations involving separate offices, contractors, shifts, and Installations. In all situations, safety responsibilities must be clearly defined in writing, and the communication of safety information among operational elements shall be emphasized.

(5) Emphasis shall be placed on identification, elimination, or control of hazards; and risk assessment. Risk evaluations will be applied in any decisionmaking process affecting the safety of personnel, equipment, and the general public. The scope or depth of these evaluations can be tailored to the complexity of the program or system being analyzed. System safety principles will be an integral part of the risk assessment of the occupational setting.

(6) Close communication will be maintained between Safety and other disciplines and organizations, e.g., Product and Quality Assurance, Occupational Health, environmental management, and program/project management.

b. Specific. Headquarters, Program, and Field Installation Directors shall be responsible for ensuring that:

(1) The safety organization is placed at a high enough level so that the safety review function can be conducted independently, the safety responsibilities of each organizational element are properly emphasized and accomplished, and adequate resources are available to support the safety efforts.

(2) Policies, plans, procedures, and standards that define the parameters of the safety program are established, documented, maintained, communicated, and implemented to provide for the appropriate or

adequate protection and prevention of loss and damage to personnel, property, material, equipment, and facilities of NASA, other agencies, and the public.

(3) Contractor operations and designs are reviewed and evaluated for compliance with the safety provisions of the contract and good safety practices. These results will be provided to the award fee boards, where applicable. NASA safety personnel also shall be regular participants in the procurement process for the acquisition of hardware software, services, materials, and equipment. See Chapter 2.

(4) An effective program system safety effort is established to include development, review, and approval of project planning documents and the development and use of a risk assessment/hazard control system as described in Chapter 3.

(5) Qualified personnel and appropriate professional safety training are provided to support the safe performance of potentially hazardous or critical technical operations and to ensure a qualified safety workforce is available to support the safety assurance function. See Chapter 4.

(6) An independent interagency review and approval process is implemented for the use of radioactive materials in spacecraft and the Space Transportation System to avoid unacceptable radiation exposure for normal or abnormal conditions, including launch aborts with uncontrolled return to Earth. See Chapter 5.

(7) All NASA operations are performed in accordance with existing safety standards and consensus standards, or special supplemental standards when there are no known applicable standards. For hazardous operations, special procedures are developed to provide for a safe work environment. See Chapter 6.

(8) Aviation Safety Programs tailored to meet the specific operational needs of the NASA Field Installations are established and maintained to comply with national standards, and NASA directives and guidance as specified or referenced in Chapter 7.

(9) All facilities are designed and constructed to comply with applicable/approved codes, standards, and procedures as specified or referenced in Chapter 8.

(10) All facilities are designed and constructed to comply with applicable life safety codes and appropriate fire protection codes and requirements. See Chapter 9.

(11) All accidents, incidents, mission or test failures, or other mishaps are promptly investigated and continuous improvement initiated through corrective actions and lessons learned, as described in Chapter 10 and NMI 8621.1, "Mishap Reporting and Investigating."

107 COMPLIANCE WITH FEDERAL AND CONSENSUS STANDARDS

* a. The requirement for Federal agencies to provide a safe workplace is contained in Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," dated February 26, 1980. More specific regulations can be found in the 29 CFR 1960. NASA complies with the standards of OSHA, other applicable Federal agencies, and national consensus standards as stated in NHB 2710.1.

b. Unique NASA operations, materials, facilities, equipment, procedures, and practices may require establishment of alternate safety standards; or if no standards apply, NASA will develop its own supplementary safety standards. When such a case exists, standards will be issued to achieve the following objectives:

(1) Eliminate repetitive decisionmaking and duplication of design efforts or research in more than one Installation or contractor's plant.

(2) Prevent and control, to the extent possible, occupational injuries to personnel, injuries to the public, and accidental property damage.

(3) Provide for uniformity of basic safety standards throughout NASA and NASA-owned, contractor-operated facilities.

c. Standards will be issued as a NASA Safety Standard. Each Safety Standard will be identified by a title and a unique prefix and number comprising:

(1) The letters "NSS" for NASA Safety Standard.

(2) The four-digit number "1740" for Safety Standards, suffixed in consecutive order of issue by number ".1," ".2," etc.

(3) An additional suffix of "A," "B," etc., as necessary to identify revisions. An example of the second revision of a standard for pressure vessel safety would be identified as "NSS-1740.1B."

* Joint Safety and Health responsibility.

108 RISK ASSESSMENT

The safety organization must assess the safety risks or hazards associated with current or planned activities. The decision (based on all relevant factors) to accept a hazard with its associated risk is a management responsibility, and will require coordination and concurrence by the cognizant safety official and the Program Manager. If there is a lack of concurrence on the decision between management and safety at any level, Safety will elevate the decision to the next Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA) level. The probability of a mishap coupled with the severity of the possible consequences should be a major consideration in that decision.

a. Purpose of Risk Assessment. The primary purpose of risk assessment is to identify and evaluate risks to support decisionmaking regarding actions to ensure safety and mission success.

b. Risk Assessment Approach. Risk assessment analysis should use the simplest methods that adequately characterize the probability and severity of undesired events. Qualitative methods that characterize hazards and failure modes should be used first. Quantitative methods should be used when qualitative methods do not provide an adequate understanding of failure causes, probability of undesired events, or the consequences of hazards or potential failures.

c. Risk Assessment Code (RAC). The RAC is a numerical expression of risk determined by an evaluation of both the potential severity of a condition and the probability of its occurrence. The following definitions and Risk Assessment Code Matrix (Figure 100-1) are provided as guidance. Variations may be approved by the cognizant safety and program officials.

(1) Severity is an assessment of the worst potential consequence, defined by degree of injury or property damage, which could occur. The severity classifications are defined as follows:

(a) Class I - Catastrophic — May cause death.

(b) Class II - Critical — May cause severe injury or major property damage.

(c) Class III - Marginal — May cause minor occupational injury or illness or property damage.

(d) Class IV - Negligible — Probably would not affect personnel safety but is a violation of specific criteria.

(2) Probability is the likelihood that an identified hazard will result in a mishap, based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population. Probability is estimated as follows:

(a) A — Likely to occur immediately.

(b) B — Probably will occur in time.

(c) C — May occur in time.

(d) D — Unlikely to occur.

	PROBABILITY ESTIMATE			
SEVERITY CLASS	A	B	C	D
I	1	1	2	3
II	1	2	3	4
III	2	3	4	5
IV	3	4	5	6

Figure 100-1. Risk Assessment Code Matrix

d. Guidance. NMI 8070.4, "Risk Management Policy for Manned Flight Programs," provides more detailed guidance on technical risk assessment policy and responsibilities.

109 CONTROL OF HAZARDOUS CONDITIONS (FAILURE TOLERANCE)

Systems shall be designed to preclude the occurrence of a hazard or to negate the effect of the hazard that cannot be eliminated. The level of protection required is a function of the hazard severity and may be achieved by a combination of availability, reliability, maintainability (restorability), and redundance. The same level of protection against operator error is required.

a. Safety Critical Functions (e.g., Life Support in a manned spacecraft) shall be designed such that the operation of the function is assured. This can be achieved by specifying a reliability requirement for the function as a

probability and appropriate levels of redundancy. Where there is sufficient time lapse between a potential failure and manifestation of its effect, restorability or maintenance may be used as an alternative means of achieving failure tolerance.

(1) The use of the probability of failure to provide a function and an estimated time to restore the function shall be used to assess the safety attributes of the design. This shall be achieved with a demonstrated lower confidence level of 95 percent for the probability of failure, and a demonstrated mean time to restore not greater than 50 percent of the estimated time to effect. The time-to-restore estimate shall include the combination of the time to repair, as well as logistics or administrative downtime that affects the ease or rapidity of achieving full restoration of the failed function.

(2) Design features shall include a human error tolerance such that two operator errors can occur without loss of life, and 1 error without personal injury or system loss/damage.

(3) The use of redundancy to achieve failure tolerance shall require the specification of an acceptable reliability and sufficient redundancy to tolerate two failures or operator errors where loss of life could occur; one failure or operator error where system loss/damage or personal injury could occur. The use of redundancy shall include a verifiable requirement that common cause failures (i.e., contamination) do not invalidate the failure tolerance. All redundancy in safety critical functions shall be verified.

b. Safety Critical Functions shall require three inhibits (allows two failures or operator errors) where loss of life or mission-critical events could occur, and two inhibits where personal injury or system loss/damage can occur.

c. Loss of functional protection shall require termination of the operation at the first stable configuration.

NOTES:

(1) For manned systems, safe haven, rescue, and escape can be valid means of life protection, and if used, shall include testing for validation, training, and demonstration.

(2) A single level of protection is required to protect hardware. For high-value systems (high visibility), the program shall consider added protection against loss and shall document the decision and rationale.

110 NOTICE AND ABATEMENT OF UNSAFE OR UNHEALTHFUL CONDITIONS

* The receipt of information concerning unsafe conditions, whether received through a report from an employee and verified, or as a result of a workplace inspection, will require the issuance of a Notice of Unsafe or Unhealthful Condition (NF 1390) and a NASA Safety and Health Hazard Abatement Form (NF 1584) or equivalent forms. See Appendix B for sample forms. Imminent danger issues will be addressed in accordance with 29 CFR 1960.26. See NHB 2710.1 for more information.

a. Inspection requirements vary according to the type of unsafe or unhealthful conditions that are reported.

(1) An allegation of an imminent danger condition will require an inspection within 24 hours.

(2) An allegation of a potentially serious condition requires an inspection within 3 working days.

(3) Any allegation of other than imminent or serious safety or health conditions shall be inspected within 20 working days.

Further inspections may not be necessary if the hazardous condition(s) can be abated immediately through normal management action and prompt notification to employees and safety and health committees.

b. Written reports/notices of safety violations shall be issued not later than 15 working days after completion of the inspection and confirmation by the inspection official. Written reports/notices for health violations shall be issued not later 30 working days after completion of the inspection and confirmation by the inspection official.

(1) A copy of the notice shall be sent to the official in charge of the workplace, the representative of the employees, and the safety and health committee.

(2) Upon receipt of any notice of an unsafe or unhealthful working condition, the official in charge of a workplace shall immediately post such notice at or near each place where the condition exists or existed.

(3) Each notice shall remain posted until the unsafe or unhealthful working condition has been abated or for 3 working days, whichever is later.

* Joint Safety and Health responsibility.

c. Abatement Plan (NF 1584 or equivalent) must be developed for hazards that cannot be abated within 30 days. A copy shall be provided to the safety and health committee, employee representatives, and the NASA Safety and Risk Management Division if Headquarters advocacy is required to secure funding.

111 SAFETY PROGRAM REVIEWS

a. General. In addition to normal management surveillance, formal evaluation of the safety program shall be accomplished by competent and qualified safety personnel through safety surveys, safety evaluations, and in-depth safety inspections that are conducted at least annually. A formal program for the abatement of hazards shall be in place. While review of accident reports, statistics, and program documents provide a general indicator of the extent and success of the safety program, objective evaluation visits by the functional safety management officials are required to enhance accident prevention efforts and to strengthen the effectiveness of the safety programs. These evaluations shall have specific objectives:

(1) Evaluate the effectiveness of safety program management.

(2) Identify hazards and suggest corrective action.

(3) Determine the adequacy of safety standards and procedures.

(4) Observe compliance with safety practices.

(5) Assess compliance with measures taken to correct problems noted during any previous visits/inspections/surveys.

b. Review Categories. To determine the degree of formality attached to the safety reviews, the following three specific types are designated:

(1) Safety Assistance Visits are informal on-site evaluations by specialists and safety personnel who, after making spot checks and/or sampling visits and holding discussions with appropriate levels of management, provide an assessment to the affected organization.

(2) Safety Inspections are reviews conducted at the working or facility level to assess the compliance with safety policies and standards that apply to the particular workplace. Formal reports of inspections shall be provided to the appropriate management level that is responsible for correcting the violations.

(3) Safety Surveys are documented management-level reviews performed in accordance with written checklists to verify by

examination and evaluation of objective evidence, whether required safety program elements are in compliance with procedures. A written report is usually provided, and a written response containing a corrective action plan with milestone dates is required.

c. Responsibilities

(1) Headquarters Safety and Risk Management Division will sponsor safety program surveys of Field Installations and Headquarters at least biennially.

(2) Field Installations shall maintain documentation of inspections and the results for a minimum of 5 years.

(3) Installation Directors shall schedule safety reviews to ensure that all functions and areas under their purview, including contractor activities, receive frequent and meaningful evaluations.

112 ADVISORY PANELS, COMMITTEES, AND BOARDS

a. General. It is NASA's intent that maximum use be made of the nation's most competent safety resources. In keeping with this philosophy, consultants, interagency and interdisciplinary panels, and ad hoc committees, consisting of representatives from industry (management and union), universities, and government (management and union), including NASA, may be used to review and advise on the needs of the NASA Safety Program.

b. Aerospace Safety Advisory Panel (ASAP). This Panel was established by Public Law 90-67 to serve as a senior advisory body to the NASA Administrator. The panel reviews safety studies and operations plans referred to it, makes reports, and advises the Administrator with respect to the hazards to proposed or existing facilities and operations. See NMI 1156.14, "Aerospace Safety Advisory Panel," for further details.

c. Operations and Engineering Panel (O&E Panel). This internal NASA panel reports to the Associate Administrator for SMA (AA for SMA). The Panel supports the AA for SMA on special assignments related to facilities operations and engineering activities. The Panel evaluates processes and systems for assuring the continuing operational integrity of NASA test facilities, operations and engineering technical support systems, and problems and issues at the Field Installations, and provides recommendations to management in these areas. The Panel also studies technical support systems problem areas and develops alternate solutions or methods for arriving at a solution. See AA for SMQ Memorandum, dated October 23, 1990, for further details.

d. Interagency Nuclear Safety Review Panel (INSRP). The INSRP provides an independent evaluation of the radiological risks associated with the launch of a nuclear power system. The Panel members, or coordinators, representing the Department of Energy (DOE), Department of Defense (DoD), and NASA, are independent of the program under review. These coordinators are empowered by their agencies to obtain facility and personnel support from within their agencies to provide the necessary expertise to support INSRP in its nuclear safety evaluation. Besides the Panel coordinators, representatives from the Nuclear Regulatory Commission, Environmental Protection Agency (EPA), and National Oceanic and Atmospheric Administration (NOAA) also participate in the radiological risk assessment. For further information on INSRP, see Chapter 5.

e. System Safety Steering Committee (SSSC). Each Field Installation SRM&QA Director should establish a standing SSSC, independent of any specific program or project, to advise new program or project managers of the extent to which the system safety provisions of this document are applied. The Committee should be a multi-disciplinary group chaired by a senior safety professional. The Committee should be convened as early as possible in the concept phase of a new program or project to provide tailoring recommendations for safety considerations discussed in this document. When a new program or project is multilocated, the Field Installation with primary responsibility or Headquarters shall chair and add representatives from the other Field Installations involved, or request that the Program Director appoint an ad hoc committee in lieu of the expanded Field Installation Safety Panel.

(1) In addition to the chairperson, the SSSC should consist of (but not be limited to) representatives from engineering, operations, facilities, Program office, other Field Installations involved, flight crew offices (if manned flight is involved), institutional functions, life sciences, and other functions that might have extensive involvement.

(2) The SSSC shall tailor the system safety requirements by adding, revising, or deleting requirements. It should consider the potential for personnel injury, equipment loss or facility damage, and property damage. Potential impacts to NASA in terms of cost, schedule, and public involvement or interest shall also be considered.

(3) SSSC determinations shall be documented, including determinations that a program shows only very minor risk potential, or that no system safety task is required. A copy of the determination shall be sent to NASA Headquarters, Code QS.

(4) It is not the intent of this document that the SSSC have any mandate beyond the initial recommendations for tailoring the

system safety task for a new program or project. However, this document does not prohibit the convening authority at the Field Installation, or the Program/Project Director from assigning other tasks.

(5) Each project with a system safety task may have a Project System Safety Panel (PSSP) chartered by the Project Manager. The size and composition of the panel shall be determined by the project's size, type, and safety risk potential. Its purpose is to provide advice and consultation to the Project Manager and project safety representative on the safety requirements and concerns of the project. The panel should be chaired by a safety professional who is not assigned to the project, but whose position provides insight into the project.

f. System Safety Review Panel (SSRP). This Panel is a mechanism for enhancing the Space Shuttle Program (SSP) system safety management and engineering through informational interchanges, development of concepts to improve the STS safety program, review of safety documentation, review of SSP integration and cargo integration, review of SSP element-level hazard identification and resolution activities, and recommendations to Level II management for hazard report disposition. See JSC NSTSPM Directive No. 110, "Space Shuttle Program (SSP) System Safety Review Panel (SSRP) Charter," for further details.

g. Payload Safety Review Panels (Space Shuttle Program). These panels are established to review the flight and ground safety aspects of shuttle payloads. See NSTS 1700.7, "Safety Policy and Requirements for Payloads Using the Space Transportation System"; NSTS 13830, "Implementation Procedure for STS Payloads System Safety Requirements"; and KHB 1700.7, "Kennedy Space Center Payload Ground Safety Handbook."

h. Space Flight Safety Panel. This Panel was established to promote flight safety in NASA space flight programs involving flight crews and to advise appropriate AAs on all aspects of the manned space program that affect flight safety. See NMI 1152.66, "NASA Space Flight Safety Panel," for further details.

i. Senior Safety Policy Committee. The Director of the Safety and Risk Management Division has established this committee to provide a forum to address and investigate system and industrial safety issues that cannot be resolved at the local safety levels and to facilitate appropriate resolutions Agencywide. The Senior Safety Steering Committee Charter is provided in Appendix C of this document.

j. Problem Assessment Review — Payloads (PAR-P) Panel. This Panel is composed of the Safety Directors from appropriate NASA Field

Installations and the Safety and Risk Management Division (QS). The Panel will provide findings and recommendations to the AA for SMA. Each spaceflight payload program will undergo an independent assessment of the effectiveness of its safety assurance process. The assessment uses information gathered from the normal safety review process and supplemented by information presented at the Code Q, PAR-P. This review and assessment will normally be completed after the final project and vehicle reviews and concurrent with the Code M (or equivalent) Flight Readiness Review.

k. Safety and Health Committees. NASA requires the establishment of executive safety committees or boards at its Field Installations; however, the Agency has exercised its option not to use the membership format established by OSHA for such committees as set forth in 29 CFR 1960, Subpart F, "Occupational Safety and Health Committees." Guidance for committees is found in NHB 2710.1.

l. Ad Hoc Committees. Field Installation Directors may establish ad hoc committees to provide safety oversight review of programs, projects, and other activities under their purview.

113 PUBLIC SAFETY

a. NASA will strive to provide protection to the general public from any adverse effects of NASA operations. Field Installation Directors, Program/Project Managers, and line supervisors at all levels are responsible to ensure that the public is not exposed to undue hazards as a result of NASA operations. If protection can be afforded through exclusion, adequate security measures will be imposed to limit public access and exposure. If protection must be afforded by safety restriction, adequate precautions and controls will be implemented based on the hazards identified by analysis. Where the possible hazardous effects of NASA operations extend past the Installation boundary, agreements may also be needed to control public access to the affected area. Safety and emergency planning officials should establish cooperative programs with the local community including:

(1) Ensuring community awareness of the nature and extent of actual and potential hazards arising from the NASA operations and the measures being taken to protect the community.

(2) Developing joint disaster evacuation plans to include radiological contamination, explosive/propellant mishaps, toxic chemical spills, tornados, hurricanes, floods, etc.

(3) Participating jointly in community safety activities.

b. Occasionally, research personnel who are neither contractors nor visitors, are allowed access to NASA facilities to conduct individual research under grants or other auspices. These research operations must not interfere with or damage NASA facilities or operations. If their work involves exposure to hazardous operations, the Field Installation safety shall require them to follow all NASA precautions and to procure protective clothing and equipment at their own expense, if needed. Also, if these personnel will be operating or using potentially hazardous NASA equipment, they must receive training and be certified as a qualified operator in accordance with Chapter 4 of this document.

114 COORDINATION WITH ORGANIZATIONS EXTERNAL TO NASA

a. The Office of Safety and Mission Assurance (OSMA), in close coordination with the Office of Policy Coordination and International Relations, shall establish guidelines for exchanging safety information with other government agencies, private agencies, and foreign governments (e.g., Underwriters/Laboratories, Defense Logistics Agency (DLA), EPA, and space agencies of other space-faring nations). New and different methods and practices that may be beneficial NASA-wide should be brought to the attention of the responsible Headquarters office.

b. Active participation by NASA safety professionals and other NASA officials in outside job-related activities is encouraged. Examples are functions and committees of the National Safety Council, National Fire Protection Association, DoD Explosive Safety Board, National Academy of Sciences, System Safety Society, American Society of Safety Engineers, and Field Federal Safety and Health councils. Such participation shall be governed by the appropriate directives to include Office of Management and Budget (OMB) Circular A-119, and instructions issued to implement the circular.

115 MATERIAL SAFETY DATA SHEETS

* All NASA procurement activities require the referencing of 29 CFR 1910.1200 and Federal Standard 313, "Federal Standard for Preparation and Submission of Material Safety Data Sheets" (MSDS's), as revised, in commodity specifications, purchase descriptions, purchase orders, contracts, and other purchase documents. The receiving office at each Field Installation shall provide copies of the MSDS's for receipt of such commodities to the central office responsible for maintaining the MSDS records. Magnetic disk or paper copies of all MSDS's will be maintained in the work area where the material is being used or stored. See NHS/IH-1845.3, "Hazard Communication."

* Primary Occupational Health function.

116 EMERGENCY PLANNING

a. The NASA Emergency Preparedness Plan is part of the Governmentwide program to develop and maintain readiness and preparations for emergencies ranging from fires and civil riots to a full-scale military attack on the United States. Emergency plans shall be in place, discussed with the appropriate personnel, and exercised periodically for all NASA activities so that reaction to emergency situations is rapid and effective. Such plans will cover national emergencies and disasters, mishaps, and the communication of information.

b. NMI 1040.3, "Emergency Preparedness Program," and the "NASA Emergency Preparedness Plan" (QS-EPP-92-001) establish NASA policy and requirements in this regard. Field Installation Directors are responsible for preparing their organizations to handle emergencies and disasters effectively and for developing the Installation emergency plan. The guidance for developing this plan is furnished by the General Services Administration (GSA) in 41 CFR 101 and 29 CFR 1910.

117 SAFETY MOTIVATION AND AWARDS PROGRAM

This program recognizes notable safety-related contributions to NASA programs and operations. The following paragraphs establish general policy and responsibilities and identify the primary types of safety performance to be recognized:

a. NASA is committed to continued improvement of safety in all operational phases. NASA's policy is to stimulate the participation of employees in this effort. The presentation of awards is considered appropriate for recognizing outstanding safety-related performance/contributions and is an effective means of encouraging safety excellence.

b. It is NASA's safety policy to recognize responsible individuals and organizations for:

(1) Taking significant safety initiatives.

(2) Making truly innovative safety suggestions.

(3) Meeting major safety goals.

(4) Making significant achievements leading to the safer and more effective use of resources or execution of NASA operations.

(5) Encouraging and rewarding safety excellence among employees (applies to supervisors).

c. NASA safety awards shall recognize the safety achievements of NASA and other Federal Government employees supporting NASA objectives in all occupational categories and grade levels. Employees of the Jet Propulsion Laboratory (who are performing NASA work) shall be treated as Federal Government employees for safety awards. NASA safety awards programs also may provide for the recognition of non-Federal personnel supporting NASA objectives.

d. The NASA safety awards process shall be properly structured to motivate and maintain safe behavior. Appendix D provides the requirements to consider when developing safety award programs.

e. NASA Headquarters and the Field Installations shall each establish and maintain a fund for the operation of NASA safety awards programs via the annual budget process.

f. Awards can be items of minimal value in accordance with Federal guidelines; or certificates or plaques that have a more intrinsic value. (See Appendix D.)

g. Responsibility for the NASA Safety Motivation and Awards Program is as follows:

(1) The AA for SMA is responsible for the general policy direction of the NASA Safety Awards Program.

(2) The Director, Safety and Risk Management Division, is responsible for the administrative direction, operation, and evaluation of the NASA Safety Awards Program.

(3) The Directors of Field Installations and Officials-in-Charge of Headquarters Offices are responsible for establishing and maintaining safety awards programs in accordance with this document.

(4) Supervisors and managers are responsible for actively participating in the NASA Safety Awards Program and assuring that all subordinate personnel, including other supervisors, are recommended for recognition of notable safety performance.

118 SAFETY MANAGEMENT INFORMATION

Efficient communication of safety information is necessary to meet the needs of safety officials and the managers they support. This includes communications between and among operational and safety organizations. NASA safety organizations will pursue every practical means for communicating verbal and written safety management information, lessons learned, and statistics. Examples of NASA Information Systems are the Mishap Reporting and Corrective Action System (MR/CAS) and the Lessons Learned Information System (LLIS).

* a. Recordkeeping and Reporting Requirements. Records and reports of accidents, occupational injuries, incidents, failure analyses, identified hazards, mishaps, appraisals, and like items, contain information necessary for developing corrective measures and lessons learned. NASA shall maintain detailed records of occupational injuries that are reported to

OSHA in accordance with 29 CFR 1960, Subpart I, "Recordkeeping and Reporting Requirements." Detailed information is provided in NMI 3810.1, "Processing Claims Under the Federal Employees Compensation Act."

(1) Employees are allowed access to these data and their medical exposure records in accordance with Federal regulations (29 CFR 1910).

(2) NASA Headquarters requires the Field Installations to maintain records and report occupational injuries and illnesses as specified in Chapter 10 of this document.

(3) NASA also publishes a periodic Safety Program Status Report for internal Agency use.

(4) Training records are addressed in Chapter 4 of this document.

(5) Mishap reporting and investigation are discussed in Chapter 10.

(6) Participation in the Government-Industry Data Exchange Program (GIDEP) (Report Control Number 10-SMIS-00844) is required (see NMI 5310.2). This system enables broad dissemination of safety- and quality-related discrepancies in equipment and material for purposes of preventing mishaps.

* Joint Safety and Health responsibility.

b. Furnishing of Documents to NASA Headquarters. The following documents shall be forwarded to the NASA Safety and Risk Management Division Director:

(1) Safety analysis reports and hazard analyses (as requested).

(2) Installation executive safety board documentation (e.g., minutes and reports).

(3) Reports from Design Reviews, FRR's, Payload Safety Reviews and Final Acceptance Boards, and other review board reports that have safety implications (as requested).

(4) Results of internal or external (such as OSHA) safety program management reviews.

(5) Top-level Field Installation or program safety policy documents that implement Headquarters requirements.

(6) Major mishap reports as required by NMI 8621.1, and information as requested by Headquarters in Chapter 10 and Appendix N of this document.

(7) Copies of comments sent to outside regulatory agencies (e.g., OSHA, Department of Transportation (DOT), EPA) concerning proposed rule-making that could impact the NASA Safety Program.

(8) Safety abatement plans as reported using the NASA Safety and Health Hazard Abatement Form (NF 1584) or equivalent if Headquarters advocacy is required to secure funding for abatement.

119 SAFETY LESSONS LEARNED

Safety lessons learned during the performance of management and technical functional activities shall be developed and disseminated to program managers and throughout NASA Field Installations and Headquarters by cognizant personnel to improve understanding of hazards, prevent the occurrence of accidents, and suggest better ways of implementing system safety programs. In addition to contributing appropriate information to the LLIS, safety managers will include this information in program, procurement, and Field Installation newsletters to communicate more effectively with management. Lessons learned that indicate the need to revise source documents (e.g., Instructions, Handbooks, specifications, and standards) shall be submitted directly to the preparer of the document. The LLIS will provide a library of lessons learned data for use by Program Managers, design engineers, and safety personnel. Procedures for disseminating lessons learned are found in Chapter 10.

120 NASA SAFETY REPORTING SYSTEM (NSRS)

The NSRS is a confidential, voluntary, and responsive safety reporting system that provides a direct channel for NASA employees and contractors to notify the NASA Safety and Risk Management Division of safety concerns. The NSRS enables safety personnel to identify safety problems and implement corrective actions independently. The nature of corrective actions may be engineering, manufacturing, administrative, procedural, or operational. Timely information about actual hazards is of the highest priority. The NSRS has been established to collect, evaluate, and communicate such information in a timely and accurate manner. It is intended to supplement, not replace, existing reporting systems. The NSRS will be implemented at all NASA Field Installations. NASA contractors will be encouraged to implement the NSRS at their facilities.

121 SAFETY VARIANCE (DEVIATION/WAIVER) POLICY

The primary objective of the NASA safety variance policy is to define the roles of both Headquarters and the Field Installations in such a way that Headquarters will maintain control over the requirements it sets while providing the Field Installations with the responsibility and freedom necessary to accomplish their tasks.

a. The following definitions apply to the NASA safety variance approval policy:

(1) Variance: Documented and approved permission to perform some act contrary to established requirements.

(2) Deviation: A variance that authorizes departure from a particular safety requirement where the intent of the requirement is being met through alternate means that provide an equal or greater level of safety.

(3) Waiver: A variance that authorizes departure from a specific safety requirement where an increased level of risk has been accepted.

b. NASA variances do not apply to Federal and applicable State/local regulations (e.g., OSHA, CalOSHA). These regulations apply to NASA operations in full. Any variance of a Federal or State/local regulation must be approved by the appropriate Federal/State/local agency (e.g., NASA Alternate Safety Standard for Suspended Load Operations approved by OSHA). NASA Safety and Risk Management Division shall review all proposed variances of Federal/State/local regulations before submittal for approval.

c. In general, the safety organization with authority to establish a requirement is responsible for:

(1) Reviewing and ruling on variances to the requirement.

or

(2) Delegating the responsibility for ruling on variances with possible conditions placed on the approval process (e.g., requiring proper analysis, risk assessment, and safety factor limits).

d. To comply with the variance policy, the requirements that are subject to variances must be clearly defined. This is accomplished through the appropriate use of the words "shall" and "should" when writing safety requirements.

(1) Shall: The word "shall" indicates that the rule is mandatory. Noncompliance with a "shall" statement requires approval of a variance.

NOTE: Use of the word "shall" is preferred when writing mandatory NASA safety requirements; however, the words "will" and "must" also are used at times to indicate mandatory requirements and have the same interpretation as "shall."

(2) Should: The word "should" indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation. Implementation of a "should" statement is at the discretion of the local officials.

e. The Headquarters safety variance policy is provided below. It applies to all Headquarters safety requirements unless otherwise specified in the appropriate requirements document. Variance policies developed for specific safety programs shall follow this general policy as closely as possible. The Safety Variance Policy matrix is provided in Figure 100-2.

(1) Requests for variance to NASA Headquarters safety requirements for the duration of the applicable program/project, for life of the facility, or Installationwide shall be approved by the NASA Safety and Risk Management Division (QS), OSMA, within 45 days of receipt by the Division (see Figure 100-2, #1).

(2) Variance to NASA Headquarters safety requirements for a specific situation for a specific period of time, shall be approved by Installation or Program Directors or their designees. Such variances shall be for a period no longer than 45 days. They may be renewed

three times at the Installation level, after which point they must be sent to the NASA Safety and Risk Management Division for approval. (See Figure 100-2, #2.) The Installation/program shall maintain complete documentation on all approved variances, which shall include detailed analysis of the potential hazards and rationale for acceptance.

(3) The NASA Safety and Risk Management Division shall be notified semiannually of all variances to Headquarters safety requirements approved at the Installation or program levels (see Figure 100-2, #2). Notification shall include the applicable requirement; the related equipment, operation, program/project, facility, etc.; and the expiration date of the variance.

f. If a deviation is approved by Headquarters and is considered appropriate for use throughout the Agency, it shall be distributed as an interim change to the applicable Headquarters requirements document(s).

g. By reviewing the required notices and documentation, Headquarters ensures that the Installations are not approving variances that need to be submitted to Headquarters for approval.

h. Variance to safety requirements in NHB 2710.1 shall be processed in accordance with that document's variance policy.

	• DURATION OF PROJECT • LIFE OF FACILITY • INSTALLATIONWIDE (LONG-TERM)	• SPECIFIC SITUATION • SPECIFIC PERIOD (SHORT-TERM – 45 DAYS)
"SHALL"	#1 DEVIATION/WAIVER HEADQUARTERS SAFETY APPROVAL	#2 DEVIATION/WAIVER INSTALLATION/PROGRAM SAFETY APPROVAL
"SHOULD"	IMPLEMENTED AT THE DISCRETION OF LOCAL SAFETY OFFICIALS	IMPLEMENTED AT THE DISCRETION OF LOCAL SAFETY OFFICIALS

Figure 100-2. Safety Variance Policy Matrix

122 SAFETY ASPECTS OF NEW TECHNOLOGY

As NASA activities develop and refine new safety-related technical knowledge, it should be recorded in technical reports and papers and accident reports, disseminated, and applied. The information should be presented at professional seminars to broaden the technical data base.

123 SAFETY DOCUMENTATION

a. The goal of the Safety and Risk Management Division documentation effort is threefold:

(1) Update and clarify top policy directives.

(2) Separate policy from guidance.

(3) Reduce repetition and cross-linking between directives.

b. As a part of this process, the NASA Safety Documentation Tree was developed and is provided as Figure 100-3. This tree represents the four following levels of documentation:

(1) Tier 0 — Top level policy directives.

(2) Tier 1 — Safety program or element implementation documents.

(3) Tier 2 — Detailed technical requirements documents.

(4) Tier 3 — Field Installation or Program supplemental documents.

NASA SAFETY DOCUMENTATION TREE

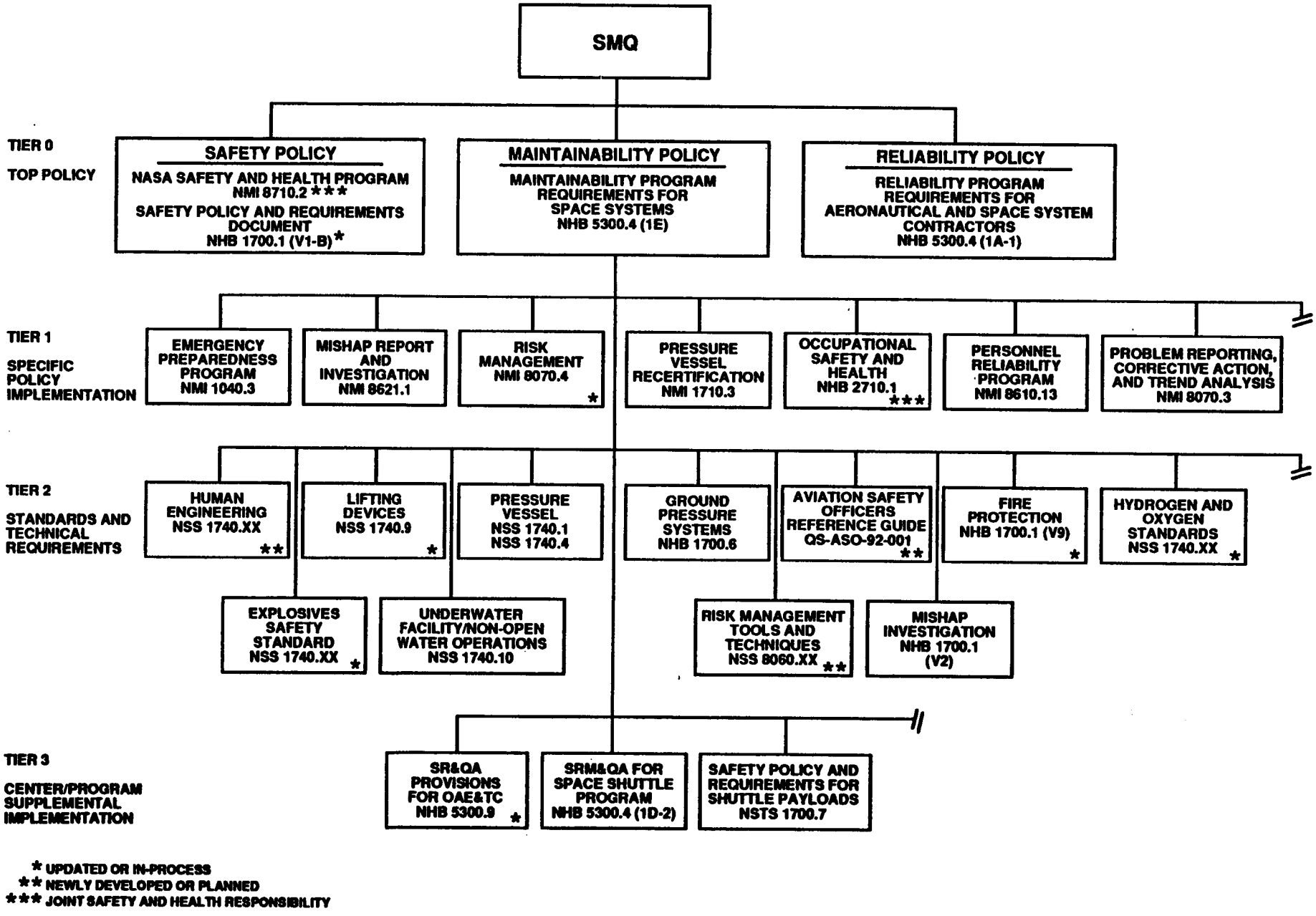


Figure 100-3. NASA Safety Documentation Tree (Typical)

This page intentionally left blank.

CHAPTER 2: SAFETY REQUIREMENTS FOR NASA CONTRACTS AND CONTRACTOR OPERATIONS

200 PURPOSE

This chapter describes the general approach for safety programs and activities of NASA contractor operations. The chapter is not a direct instruction to contractors, but provides guidance for NASA officials with responsibility for assuring safety under NASA contracts.

201 APPLICABILITY AND SCOPE

This chapter applies to NASA Headquarters and all Field Installations. It establishes the safety requirements, documentation, and procedures that must be included in all contracts that support NASA operations.

202 AUTHORITY AND RESPONSIBILITY

Safety responsibilities for NASA contracts and contractor operations will be coordinated among the program, safety, and contracting offices (and other offices as needed) as follows:

a. Program/Project Officials are responsible for:

(1) Ensuring that all procurement documentation, such as procurement requests, Requests for Proposal (RFP's)/Invitations for Bids, source evaluations, briefings, Statements of Work (SOW's), schedules, and proposed changes, are reviewed from a safety standpoint consistent with the scope of the contract.

(2) Coordinating with the cognizant safety officials to determine and approve the respective safety requirements and objectives under which the contract will be performed, including specifications, standards, and specific tasks.

(3) Ensuring that the respective safety-developed requirements and objectives are clearly delineated in the specifications, standards, and specific tasks and provided to the contracting officer for incorporation into the contract as required.

(4) Ensuring performance of the required checks and inspections of contractor compliance with the safety requirements of the contract.

(5) Ensuring that surveillance of contractor safety matters is appropriately tailored to the nature of the procurement.

b. Contracting Officers receive their direction from the Federal Acquisition Regulation (FAR) and the NASA FAR Supplement (NFS), and shall be responsible for:

(1) Negotiating safety provisions of contracts, including the Contractor's Safety Program Plan (SPP), in accordance with pertinent procurement regulations and policies.

(2) Ensuring that solicitations are not issued and contracts are not executed until appropriate program/project management and safety officials have furnished specifications, standards, and the specific contractor safety tasks that are defined in the basic contract.

(3) Obtaining the expert advice of appropriate safety officials in source evaluations, contract negotiations, contractor safety program evaluations and inspections, and award fee determination.

(4) Resolving differences with contractors with respect to safety matters upon advice or notification of the supporting safety official.

(5) Delegating appropriate authority to the Contracting Officer's Technical Representative (COTR) to ensure that the safety provisions of the contract are adequate and are being followed and that safety issues are coordinated with the appropriate safety officials.

(6) Ensuring full consideration has been given to the effective utilization of Contract Administration Services (CAS) personnel in safety monitoring or reviews of contractor operations (see FAR 42.302(a) and NFS Subpart 18-42.202-70(b)). Letters of Delegation should provide specific instructions to CAS personnel. NASA CAS management should be accomplished according to NHB 5300.4(2B-2), "Management of Government Quality Assurance Functions for NASA Contracts."

c. Safety Officials

(1) The NFS outlines the role of the Field Installation safety officials in support of procurement activities (see NHB 5100.4, "Federal Acquisition Regulation Supplement (NASA/FAR Supplement")).

(2) Safety officials are responsible for:

(a) Reviewing and providing safety input for documents (including requirements, objectives specifications, standards) and specific tasks.

(b) Serving as a member or technical advisor on safety matters during Source Evaluation Board (SEB) procedures. Such technical support includes the review of prospective contractor safety performance history and evaluations of proposals for safety-related deliverables in accordance with SEB procedures during bid evaluations and source selection.

(c) Providing the contracting officer a draft Safety Management Plan (SMP) or details of safety requirements to be included in the bid package to assist prospective bidders in developing a draft SPP.

(d) Reviewing, approving, or disapproving contractor safety program plans and safety restrictions in grant programs.

(e) Conducting safety program reviews or technical evaluations of the contractor's operation or product for safety, including compliance with safety provisions of the contract, and providing this information to the Contracting Officer, award fee boards, or final acceptance boards.

(f) Ensuring safety participation in critical reviews and events such as hardware design reviews, test program specifications development, readiness reviews, design certification reviews, facility design criteria approvals, site activation reviews, operational test procedure reviews, aircraft test criteria reviews, and SEB's.

(g) Investigating, as requested, contractor mishaps, advising contractor-appointed investigation boards, and evaluating the adequacy of followup corrective measures.

(h) Reporting contractor mishaps or test failures in accordance with Chapter 10 of this document.

(i) Determining the need for a contractor-developed hazard analysis/assessment.

(j) Examining on-site areas where NASA contractor work is being performed, notifying the contractor and the Contracting Officer of any hazards noted, and recommending corrective actions.

(k) When delegated, coordinating safety surveillance requirements of contractor operations with the appropriate Defense Contract Management Command (DLA) Defense Contract Management Command (DCMC) Specialized Safety

personnel. DCMC specialized Safety personnel may assist in the accomplishment of any or all of the responsibilities listed above.

d. Assistant Administrator for Procurement will:

(1) Publish the appropriate standard safety clause in the NFS.

(2) Consult with and obtain the concurrence of the Director, NASA Safety and Risk Management Division, concerning safety clause deviations requiring the approval of the Associate Administrator for Procurement in accordance with NFS Subpart 18-23.7004, "Contract Clause," and NFS Subpart 18-1.4, "Deviations From the FAR."

203 REQUIREMENTS .

To ensure adequate safety programs, NASA safety requirements for contracts must be appropriate and effective. To this end:

a. Provisions for suspending work will be established in cases where safety considerations warrant such action, and will be included in the contract.

b. Contractors will (as applicable) design, produce, or develop products or equipment, or manage facilities that can be operated and inhabited in compliance with NASA and Occupational Safety and Health Administration (OSHA) standards without modifications or restrictive procedures.

c. Contractors shall be held responsible for maintaining a safe work environment, including the provision of necessary protective clothing and equipment unless provided as Government Furnished Equipment (GFE). The contractor's compliance with NASA and OSHA safety standards will be contractually binding as prescribed by law.

d. Contractors shall be required to provide the Contracting Officer with information on the use of any hazardous materials that could present a risk or hazard to NASA operations or personnel. The Contracting Officer or safety official will require copies of Material Safety Data Sheets (MSDS's) for new hazardous materials. Hazard analyses/safety risk assessment will be developed and provided to NASA for approval before the start of any hazardous deliverable work or support operations as directed by the Contracting Officer.

e. Contractors shall be required to submit appropriate safety documentation during the procurement process, e.g., draft SPP's and corporate safety policies, to assist the source selection official in evaluating the loss prevention program of the contract bidders. A final SPP shall be

submitted in accordance with the contract. See paragraphs 206, 207, and 303(a)(3)—(7) and Appendix E. When the requirement for an SPP is waived (see subparagraph 207b) or otherwise not required by the nature or size of the contract, a single safety point of contact will be provided as a minimum.

f. Contractors will be required to develop motivation, awareness, training, and certification programs for their employees in safety matters. This will include regularly scheduled safety meetings for supervisors, foremen, and employees in accordance with the contractor's SPP. Training will be documented in accordance with NASA and OSHA requirements.

g. Contractors will be required to report safety data on mishaps, close calls, and lessons learned as indicated in Chapter 10 of this document in accordance with OSHA and NASA requirements. Investigation of contractor mishaps will be performed in accordance with investigation procedures as specified in the contractor's SSP. The Contracting Officer or the safety COTR will evaluate and verify implementation of corrective actions.

h. Contractors will monitor and self-evaluate activities for compliance with the safety provisions or requirements of the contract. Contractor activities also will be properly monitored and evaluated by NASA officials (or delegated agencies). These safety program reviews will be conducted to note and correct any safety problems at an early stage.

i. Access to contractor activities, for purposes of determining the adequacy of safety measures, will be provided to the Contracting Officer or safety officials.

j. Contractors collocated on-site at NASA facilities will be required to comply with Field Installation safety and emergency planning requirements. Contractor points of contact and their safety responsibilities will be documented and implemented for all contractor operations with safety implications.

k. Contractors shall be required to properly reflect the "flow-down" of safety responsibilities between appropriate tiers (i.e., subcontractors).

204 CONTRACTOR RELATIONSHIPS WITH OSHA

a. Responsibility. NASA contractors are not relieved of their responsibility to comply with all applicable Federal and state OSHA requirements. NASA authorities will award work on the basis of contractor compliance with OSHA standards and Public Law 91-596, "Occupational Safety and Health

Act." Contractors will assess all Government Furnished Property (GFP) or Facilities (GFF) associated with the contract and indicate areas of noncompliance with OSHA standards to the safety COTR.

b. Access of State or Federal Compliance Safety and Health Officers. Compliance safety and health officers are persons authorized by the OSHA, U.S. Department of Labor (DoL), to conduct inspections. Federal (OSHA) or state compliance safety and health officers will be allowed on NASA Installations to review and survey contractor operations and investigate mishaps. If the state does not have a DoL-approved Safety Plan or the Installation is under exclusive Federal jurisdiction, only Federal compliance officers shall have the right of access to contractor operations. Unless exclusive Federal jurisdiction is claimed by Federal OSHA, both Federal and State OSHA investigators will be allowed to investigate a contractor mishap occurring on a NASA Installation. The NASA Safety and Risk Management Division or Occupational Health Division as applicable and the DASHO will be notified of OSHA's (Federal or State) impending investigation and will be provided the results of their investigation.

c. Contractor Citations. Under Public Law 91-596, an employer is responsible for providing employees with safe working conditions regardless of where the employees are working. Thus, the contractor must submit a timely reply to any OSHA citation received. The contractor is responsible for settling citations issued against the operation unless covered by subparagraph 204d.

d. Contractor Citations Involving Government Furnished Property or Facilities. If cited for exposing its own employees to hazardous conditions involving GFP or GFF, a contractor, as the immediate employer, must respond to the citation. However, because of the shared responsibilities (the GFP or GFF is supplied by NASA, but the contractor is responsible for its safe use, the contractor and NASA will enter into negotiations to determine their respective liabilities. To continue the contractor operations, the Contracting Officer has the following options:

(1) Recommend that the contractor assist NASA in developing and obtaining DoL approval for an alternate standard that provides equivalent or greater protection for affected employees.

(2) Recommend the contractor negotiate for a replacement of the unsafe GFP or GFF with contractor-owned property.

(3) Recommend replacement with other suitable GFP or GFF.

(4) Authorize modification of the GFP or GFF at contractor expense with the understanding that title to any nonseverable modification is vested by the Government. (This will probably be an option for small modifications only.)

(5) Authorize modification of the GFP or GFF by the contractor at Government expense. Necessary funding approvals will be required pursuant to NASA regulations.

(6) Recommend that the contractor request from DoL or the state a variance from the pertinent standard.

205 NASA FAR SUPPLEMENT PROCUREMENT REGULATION

* NASA requirements for inserting general safety and health provisions in contracts appear in the NFS Part 18-23, which also outlines safety requirements. Certain requirements in particular contracts will be mandatory. Any additional specific program safety requirements will be stated in the Special Conditions section of the contract specifications, and tailored to the procurement action. These requirements shall be set forth in the schedule of the contract to ensure adequacy and appropriateness in (but not limited to) such matters as: (1) system safety, (2) aviation safety, (3) fire safety, (4) hazardous material handling, (5) health hazards, and (6) references to specific program or project safety or health standards with which compliance will be required.

206 SPECIFIC SAFETY DOCUMENTATION TO SUPPORT SOURCE EVALUATION BOARD ACTIVITIES

Based upon program/project official input, and as part of the RFP, the Contracting Officer shall require that each bidder or proposer provide in their initial proposal submission, pertinent safety documentation, e.g., draft contractor SPP proposal, and copies of the Bureau of Labor Statistics Log and Summary of Occupational Injuries and Illnesses (OSHA Form 200) for the past 2 years for the division of the company affected. These documents will be provided to the cognizant safety official or safety COTR for review in accordance with the SEB evaluation plan. This review will be used to provide input to the SEB on the contractor's ability to meet the safety requirements. The Contracting Officer, in conjunction with program/safety officials, will determine the degree to which this requirement is levied, based on the degree of risk associated with the contract and the overall cost. Lists of deficiencies in the contractor's past safety performance and recommendations provided by safety officials should be used in determining source selection. This is feasible only for those contractors with previous work experience at or for the Installation/program. This will not be used to provide an unfair advantage to contractors without previous experience at the Installation.

* Joint Safety and Health responsibility.

207 SAFETY PROGRAM PLANS

a. SPP's explain in detail how the contractor or NASA will implement the requirements of this document and the NASA FAR Supplement. The degree of detail will depend on the type and scope of the contract requirements. It is not intended that the contractor's normal industrial home-plant safety rules and directives be subject to NASA approval. Rather, it is intended to ensure that the contractor has adequate safety programs and has not neglected safety in the interest of obtaining a more favorable bid in the short term. The SPP shall furnish specific information on how the contractor intends to protect the life and well-being of contractor and Agency employees and the public, as well as any appropriate NASA property and equipment during contract performance. When implemented by the contractor, the SPP will ensure that all known hazardous conditions that may be detrimental to contract performance or progress are identified and resolved before operations begin.

b. The contractor will be required to submit SPP's to the Contracting Officer for safety review by the safety COTR and to obtain NASA approval before the startup of operations. This should occur before start of work on deliverable items, unless waived in accordance with FAR or the Contracting Officer specifically exempts the requirement in accordance with FAR. SPP's will normally not be required for nonhazardous, small purchases, or low-dollar contracts as discussed in the NASA FAR Supplement. Changes to the SPP may be made during the pre-work briefings and must be reviewed by the safety COTR. All approved changes shall be signed by both the contractor and Contracting Officer and reflected in the minutes. Draft plans also can be submitted and used to assist in contractor selection during SEB evaluation.

c. Contents of the Safety Program Plan. An outline of the contents of an SPP, as applicable, is provided in Appendix E.

208 CONTRACTOR PRE-WORK BRIEFING

Contractors shall be briefed (formally or informally) on safety requirements by the Contracting Officer or designee before beginning work, and on procedures to follow in event of a mishap. The contractors also shall be informed of the adjacent NASA and other contractor operations that could pose a hazard to their operation and employees. Standard briefing checklists developed by the Field Installation safety office may be used. Minutes and attendance record should be kept.

209 SAFETY PROGRAM REVIEWS

Field Installations are expected to have appropriate, adequate, and effective contractor safety surveillance and evaluation programs. In those instances where the safety and health clause is prescribed as set forth in the NFS, the contractor's approved safety programs, including actual performance and accident experience, will be evaluated during the initial stages of contract work to ensure early correction of deficiencies and, subsequently, will be evaluated at least annually throughout the life of the contract. The depth of the evaluations and the techniques employed should fit the extent of hazards and the importance of the program. NASA Headquarters and Field Installation safety program review teams, respectively, may conduct selected (announced or unannounced) reviews of contractor operations.

210 GRANTS

The safety special condition in research grants involving performance on certain NASA facilities or GFE whose use may pose a significant safety or health risk is an integral part of the grant document. Before being given access to the NASA facilities or equipment, the grantee shall submit a hazard assessment to the grants officer. Based upon the perceived risk, a safety and health program plan, as required, shall be developed by the grantee and approved by the grants officer or designee. The special condition requires the same mishap reporting and investigating requirements as under contracts.

This page intentionally left blank.

CHAPTER 3: SYSTEM SAFETY

300 PURPOSE

This chapter establishes policies and requirements for the implementation of system safety processes to ensure the identification and reduction of Program safety risks to an acceptable level.

301 APPLICABILITY AND SCOPE

a. For simplicity in this chapter, "Programs" shall be interpreted to include programs, projects, and acquisitions. "Program management" includes program, project, and acquisition management. When the work is performed in-house at NASA, the term Contractor shall be interpreted to apply to the in-house activity.

b. It is NASA policy to implement system safety tasks for system acquisitions, in-house developments, facility design/modifications, and agency operations and activities. The practices described in this chapter apply to (1) all NASA organizations, (2) all Programs, and (3) the Jet Propulsion Laboratory (JPL) as directed by NMI 1410.3, "Application of the NASA Management Directives System to the JPL." For joint ventures between NASA and other parties including commercial services, interagency efforts, and international partnerships, application of these practices shall be as specified in related contracts, Memoranda of Understanding, NMI's, or other documents, and will consider the degree of NASA responsibility in the venture.

c. The degree of implementation of specific requirements contained within this chapter for a given program shall be based on the advice of an appointed group (see paragraph 112e). The selected requirements will consider the potential for personnel injury, equipment loss or facility damage, property damage, potential impacts to NASA in terms of cost and schedule, and public involvement or interest.

d. Tailored system safety tasks shall be initiated during the concept phase and shall address all aspects of the life cycle of:

(1) Aeronautical systems.

(2) Space flight systems (manned and unmanned).

(3) Payloads (spacecraft, internal and external payloads and experiments flown on aircraft, Space Shuttles, Space Station Freedom, Expendable Launch Vehicles (ELV's), balloons, sounding rockets).

(4) Facilities.

(5) Support equipment, including ground and airborne, test, maintenance, and training equipment.

(6) Related safety-critical software.

(7) Operations and supporting activities, including:

(a) Construction, fabrication, and manufacture.

(b) Experimentation and test.

(c) Packaging and transportation.

(d) Storage.

(e) Checkout.

(f) Launch, flight, use, reentry, retrieval, and disassembly.

(g) Maintenance and refurbishment.

(h) Modification.

(i) Disposal.

e. Programs with existing, approved system safety tasks containing adequate definition of the risk assessment and management process are not required to comply with new requirements of this chapter, but any changes made in their system safety task must comply with this chapter. This chapter shall not supersede or prevent the application of more stringent requirements imposed by programs internally.

302 OBJECTIVE

The principal objective of a system safety task is to provide for an organized, disciplined approach to the early identification and resolution of hazards to reduce the safety risk to the lowest possible level consistent with NASA policy, Program requirements, and technology availability. It is the system safety goal to provide input to safety risk management decisions by:

a. Methodically identifying program system hazards beginning in the concept phase and continuing throughout all phases of the life cycle including disposal.

b. Eliminating hazards whenever possible. If the hazards cannot be eliminated, all practicable steps will be taken to control them in a timely, cost-effective manner per paragraph 102f.

c. Assessing the remaining safety risks either qualitatively or quantitatively, and tracking them for the life of the Program.

d. Providing the safety risk assessments to the appropriate management level for a decision to further reduce (or eliminate) or accept the risk.

e. Documenting the management decision and rationale regarding acceptance of safety risks.

303 RESPONSIBILITIES

a. NASA Program Managers shall:

(1) Implement a system safety process based on the loss potential of the Program and provide adequate resources to achieve the safety objectives. A "rule of thumb" is to use 3 to 5 percent of direct engineering and operations manhours, depending upon program complexity, to estimate "adequate" resources.

(2) Assign a System Safety Manager (SSM), in coordination with the Field Installation Safety, Reliability, Maintainability, and Quality Assurance (SRM&QA) Director, to have specific responsibility for executing the system safety task. The SSM will report to the Program Manager for program direction and to the Field Installation safety official for policy and technical direction.

(3) Publish and maintain an approved NASA Safety Management Plan (SMP), appropriate to the program (see Appendix F), for the life of the program. The Program Manager shall require contractors or in-house acquisition organization to publish, implement, and maintain an Safety Program Plan (SPP) (see Appendix E) before the startup of operations or commencement of work on deliverable items, unless waived in accordance with the Federal Acquisition Regulations (FAR's) unless the Contracting Officer specifically exempts the requirement in accordance with FAR. A draft SPP or sufficient details of the planned safety program shall be required with the Request for Proposal (RFP) response and be considered by the Source Selection Board (SSB) in evaluating a contractor's understanding of the system safety task. The Program Manager is responsible for approval of the NASA SMP and contractor SPP's. These plans may be provided separately or incorporated in more comprehensive safety or Safety and Mission Assurance (SMA) plans, providing the required data are identifiable and complete.

(4) Provide an independent system safety review process to advise the Program Manager on the status of the system safety task; provide peer review of system safety products and reports; and make recommendations on the acceptance/nonacceptance of safety risks.

(5) Provide for performance of those system safety analyses appropriate to the Program and the system safety oversight by NASA, based on recommendations from the SSM. This task requires access to and interaction with the engineering, integration, and operations functions to ensure identified hazards are addressed at the earliest practicable time.

(6) Require formal Hazard Reports (HR's) (see Appendix G) for each program hazard with a residual risk, to be formally accepted (baselined) before the Design Certification Review (DCR) or equivalent review for facilities acquisition projects. All residual risks must be formally accepted in writing to close the HR. Only the Program Manager may accept residual critical and catastrophic safety risks identified in the HR's by the system safety analysis process.

(7) Ensure that Program directives, specifications, and standards provide for uniform and systematic application of safety policy and requirements.

b. Assigned SSM shall:

(1) Exhibit the appropriate technical and managerial training and expertise for conducting an effective safety process.

(2) Advise the Program Manager regarding NASA requirements for and status of the system safety task.

(3) Manage the system safety task for the Program Manager by executing the following tasks:

(a) Develop the SMP for the Program Manager and review contractor or in-house SPP's for approval/disapproval recommendations.

(b) Organize the system safety effort to ensure maximum effectiveness in interacting with engineering, operations, integration, and Program management.

(c) Develop technical safety requirements, and ensure their incorporation into Program requirements, specifications, and planning documents.

(d) Determine the required hazard analysis tools and techniques (see Appendix H) to ensure compliance with NASA and Program safety policy and directives. The selected tools and techniques shall be used in an iterative process to identify all Program hazards, causes, detailed control requirements, and control verifications.

(e) Ensure that adequate numbers of personnel are assigned to perform system safety tasks, with appropriate experience and skills for the task, and provide for training when necessary.

(f) Determine reporting requirements for all levels to support the system safety task, originating organization (i.e., contractor, element, NASA organization), criteria for submittal (milestone, periodic, event), format, and distribution, and ensure the program provides for submittal of the required reports.

(g) Ensure submitted HR's contain sufficient residual risk management information based on the hazards identified to permit the Program Manager to make informed risk management decisions.

(h) Conduct periodic reviews of the system safety tasks keyed to Program milestones. Prioritize safety risks at each milestone and recommend to the Program all engineering, procedural, or other changes necessary to reduce safety risks. Provide sufficient technical data for each risk to permit the Program Manager to:

i Revise the test, operation, or mission to reduce the exposure of the risk, or impose constraints to control exposure to high risks.

ii Change the hardware or procedures to reduce the risk.

iii Accept the risk.

(i) Identify the need for and participate in trade studies concerning the resolution of hazards in all phases of the Program.

(3) Assist the Program Manager in establishing the Project System Safety Panel (PSSP). (See paragraph 112e(5).)

(4) Participate in the readiness review process for the tests, operations, supporting facilities, and/or flight of Program hardware. For each significant event, provide the Program Manager with the following:

(a) A safety assessment with emphasis on changes to the baseline safety risk.

(b) A safety certification of readiness with any exceptions arising from safety issues and concerns.

(5) Ensure the implementation of a closed loop system to provide traceability and tracking of all hazards from identification through resolution, and maintain an up-to-date data base of identified hazards throughout the life of the Program.

(6) Maintain safety oversight of the Program tests, operations, or activities at a level consistent with mishap potential for the life of the Program.

(7) Keep the Office of SMA apprised of the status of the system safety tasks through this office's channels, particularly problem areas that may require assistance from Headquarters.

(8) Support the Office of SMA independent safety assessment process (e.g., Space Shuttle Prelaunch Assessment Reviews) to determine readiness to conduct tests and operations having significant levels of safety risks, and provide real-time safety assessments to the Office of SMA, when appropriate, while tests and operations are in progress.

304 SYSTEM SAFETY RISK ASSESSMENT

The system safety task is a principal factor in the understanding and management of safety risk through the hazard analysis and risk assessment process (see paragraph 108). Hazards are identified and resultant risks are assessed by considering frequency of occurrence and severity of consequence. Risk may be assessed qualitatively or quantitatively. Safety risk assessment is an integral part of the overall program risk management decision process.

305 SAFETY ACTIVITY PHASES

As presented in Figure 300-1, System Safety Activities and System Life Cycle Phases, the hazard analysis process begins in the Conceptual Phase and continues throughout the program's life in varying degrees. This involvement begins once the system allocation process has identified and assigned the functional responsibilities among the systems and subsystems for system design and development. The system safety hazard analysis effort must be structured to permit a continuing and iterative process for inputs to be considered as the system design progresses and matures.

306 SYSTEM SAFETY TASK PLANNING

a. System safety task planning details the tasks and activities of system safety management and system safety engineering required to identify, evaluate, and eliminate or control hazards throughout the system life cycle. This planning provides a basis of understanding between NASA and the contractor of how safety will be applied during all phases of the Program. It establishes a formal, disciplined process to achieve the system safety objectives.

b. The NASA Program SMP shall be the vehicle for Program safety task planning. The SMP and its contents are described in Appendix F. The Program SMP shall require formally submitted SPP's, for approval in accordance with paragraph 203e and Appendix E.

307 SYSTEM SAFETY ANALYSES

a. System safety analyses provide a means to systematically and objectively identify hazards, determine their risk level, and provide the mechanism for their elimination or control. This is an iterative process that begins in the Conceptual Phase and extends throughout the life cycle including the Disposal Phase. Functions supported by the analyses include:

(1) Providing the foundation for the development of safety criteria and requirements.

(2) Determining whether and how the safety criteria and requirements provided to engineering have been included in the design.

(3) Determining whether the safety criteria and requirements created for design and operations have provided an acceptable level of risk for the system.

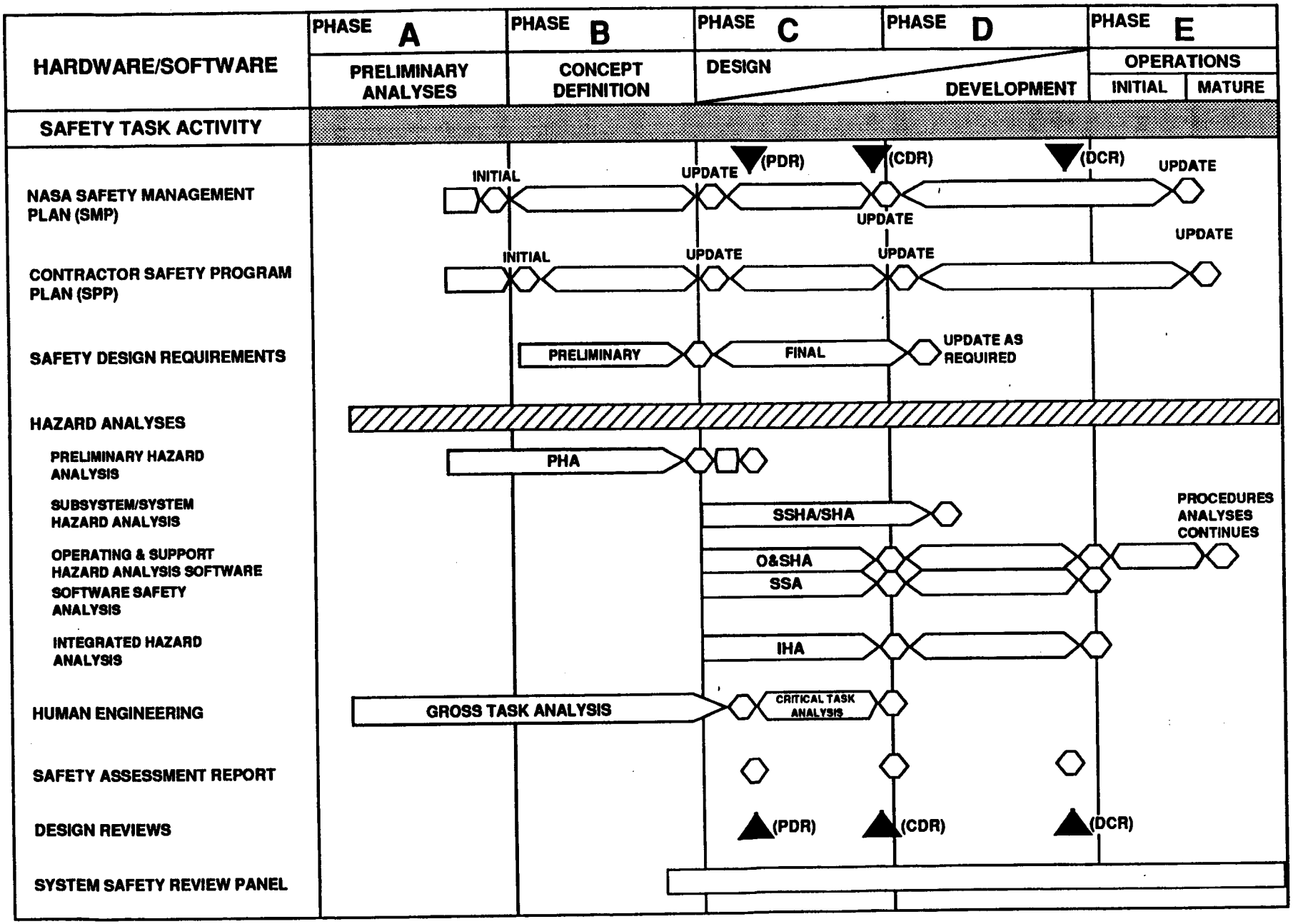


Figure 300-1. System Safety Activities and System Life Cycle Phases

(4) Providing a partial means for developing pre-established safety goals.

(5) Providing a means for demonstrating that safety goals have been met.

The extent and depth of analysis required to meet these five functions will be determined by system complexity and loss potential.

b. During the hazard identification process, it is essential to remain non-judgmental about the associated probabilities, severities, and corrective actions. Once identified, hazards shall then be ranked by severity, probability of occurrence, and program impact (risk assessment). Sufficient analyses must be performed to assess the likelihood of occurrence (usually qualitative for early assessments) for each identified undesired event.

c. There are several types of analyses necessary to identify all the hazards, some of which are specialized and others which, as designs mature, build on previously accomplished analyses.

(1) The first safety analysis is the Preliminary Hazard Analysis (PHA), which shall be performed in the Conceptual Phase. Other primary analyses shall include the Subsystem Hazard Analysis (SSHA), Software Hazard Analysis (SWHA), System Hazard Analysis (SHA), Operating and Support Hazard Analysis (O&SHA), and Integration Hazard Analysis (IHA), unless otherwise indicated by the PHA.

(2) The hazard analyses should use data developed by other types of analyses when available, such as the Failure Modes and Effects Analysis/Critical Items Lists (FMEA/CIL), Operations Analysis, Human Engineering Analysis, and Maintainability Analysis. The safety analyst may have to develop specific, limited data to support the hazard analyses if the other analyses are not performed.

See Appendix H for further information on these analysis processes and techniques.

308 SYSTEM SAFETY PROGRAM REVIEWS

The Program Manager, or his designated agent (e.g., the PSSP), shall conduct one or more system safety reviews depending on the complexity of the system. These reviews may be in conjunction with other program milestones such as the Preliminary Design Review (PDR) and Critical Design Review (CDR). The purpose of these reviews is to evaluate the status of hazard analyses, residual

risks, hazard controls, verification techniques, technical safety requirements, and program implementation throughout all the phases of the system life cycle. The emphasis in these reviews is on evaluation of the management and technical documentation.

309 DOCUMENTATION

a. The system safety task requires creation and maintenance of documentation that provides ready traceability from the baseline safety requirements, criteria, and effort planned in the conceptual phases through the life cycle of the program. All pertinent details of the hazard analysis and review shall be traceable from the initial identification of the hazard through its resolution and any updates, until such time in the Program as it is no longer applicable.

b. A Safety Assessment Report (SAR) shall be submitted to management by the contractor at the PDR, CDR, and DCR (and other milestones as may be required by the Program) to document the status of the system safety task. The SAR shall summarize the work to date in terms of hazard analyses completed, HR's submitted, significant safety assessments, tasks in progress, and tasks that are anticipated to begin prior to the next review. The report will contain a listing of residual risks baselined (or ready for baseline) and a listing of potential risks that have yet to be resolved. See Appendix G for further information on HR's.

c. Management and technical changes that impact on the established safety baseline shall be documented. Adequate resolution of the hazards shall be verified and Program Manager acceptance of the risk shall be documented to provide a complete audit trail.

310 CHANGE REVIEW

Systems are changed during their life to enhance capabilities, provide more efficient operation, and incorporate new technology. With each change, the original safety aspects of the system could be impacted, either increasing or reducing the risk. Any aspect of controlling a hazard could be weakened, new hazards could be created, or conversely, hazards could be eliminated. Even a change that appears inconsequential could have significant impact on the baseline risk of the system. Accordingly, each proposed system change shall be subjected to a safety review or analysis as appropriate to assess the safety impact; HR's will be updated when required to show any identified risk change. Each change initiator shall ensure that safety personnel assess the potential safety impact of the proposed change and any changes to the baseline risk. Changes proposed to correct a safety problem also shall be analyzed to determine the amount of safety improvement (or detriment) that would actually result from incorporation of the change.

311 PROCUREMENT

a. Procurement for design, development, fabrication, test or operations of systems, equipment, and facilities shall include appropriate system safety requirements. System safety tasks shall be specific so that potential bidders clearly understand the system safety requirements. Specific tasks provide a basis to evaluate bids for compliance with the safety requirements. A preliminary NASA SMP can be provided to prospective bidders to direct them concerning the organization/system interfaces and integration to use in developing a draft SSP.

b. Safety personnel shall:

(1) Participate in the development of the system safety tasks.

(2) Where applicable, prepare a Program SMP for the solicitation, and provide a review of the bidder's SSP or other similar safety program data.

(3) Participate in potential bidders' on-site visits and pre-bid conference to ensure that system safety provisions are understood.

(4) Provide safety input to the Source Evaluation Board.

(5) Conduct independent assessments of contract system safety deliverables.

312 REFERENCES

Appendix A contains examples of programmatic documents that might be used to assist in formulating system safety task management requirements for new programs.

This page intentionally left blank.

CHAPTER 4: SAFETY TRAINING AND PERSONNEL CERTIFICATION

400 PURPOSE

This chapter describes the requirements for establishing safety training programs and minimum certification levels for personnel involved in potentially hazardous NASA operations.

401 APPLICABILITY AND SCOPE

This chapter applies to all NASA employees and to NASA contractors in support of NASA operations in accordance with the terms of the contract. This chapter is not a direct instruction to contractors, but provides guidance for NASA officials with responsibility for ensuring compliance for safety training programs and personnel certification within NASA contracts.

402 RESPONSIBILITIES

a. Annual Review. Each NASA Installation will annually review all operations being performed at the Installation to ensure that the safety training program is working effectively and to identify and enter into the program all those jobs that are potentially hazardous in addition to the mandatory listing in paragraph 405. Employee safety committees, employee representatives, and other interested groups should be provided an opportunity to assist in the identification process.

b. Acceptance Standards. Delegated Agency personnel (e.g., Defense Contract Management Command (DCMC)) used to enforce NASA activities shall meet the training requirements of the delegation or the appropriate, accepted standards (e.g., DLAM 8280.1, "Specialized Safety Manual").

c. Training and Personnel Development Offices. Field Installation training and personnel development offices, with assistance as needed from the Field Installation Safety Officials, will be responsible for coordinating safety and certification training needs and overseeing those training efforts. Typical responsibilities are as follows:

(1) Identification of training needs.

(2) Identification of budget requirements for training.

(3) Development of training courses and materials.

(4) Assurance that training records reflect employee safety training.

d. Safety Office. Responsibility for overall policy development of the safety certification program rests with the Field Installation Safety Official. Each line organization is responsible for managing the certification program for its employees and contractors in accordance with policy in this document.

* e. Medical Office. This Office oversees or conducts the required medical examinations in support of the safety certification effort and ensures compliance with Occupational Safety and Health Administration (OSHA) and other Federal, State, and local agency medical monitoring and recordkeeping requirements. The Medical Office shall determine the depth, scope, and frequency of medical examinations. The Medical Office is also responsible for medical certification in health hazard and related activities.

f. NASA Headquarters. The role of the NASA Safety and Risk Management Division will be to assist its Field Installation counterparts in ensuring that 29 CFR Part 1960 requirements are followed and that appropriate Agencywide uniformity exists in the NASA safety training program. The Safety and Risk Management Division will act as a clearinghouse for information regarding available safety training courses and materials and it will develop, in conjunction with the Training Development Division at NASA Headquarters, training courses suited to specific Agencywide safety needs. The NASA Safety and Risk Management Division, in conjunction with the Occupational Health Office, will co-develop training courses and materials in areas of overlapping regulatory or programmatic responsibility.

403 SAFETY TRAINING

Training must be provided to assist managers/supervisors and employees in their specific roles and responsibilities in the Safety programs. Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees," dated February 26, 1980, and 29 CFR 1960 (Subpart H) require that NASA establish comprehensive safety training programs. See NHB 2710.1, "Safety and Health Handbook — Occupational Safety and Health Programs."

404 PLANNING AND IMPLEMENTATION

a. Safety Training Program. A comprehensive safety training program will be formulated by each Field Installation. The following should be considered in developing the safety training program for all employees:

(1) Management commitment to establish and implement comprehensive safety training programs (ideally, this should be in the form of a policy statement issued by senior management).

* Joint Safety and Health responsibility.

(2) Recognition of OSHA, NASA, National Fire Protection Association (NFPA), Federal Aviation Administration (FAA), Environmental Protection Agency (EPA), and other training requirements.

(3) Identification of employee training groups within the Field Installation population and determination of present training levels.

(4) Identification of specific tasks, hazardous conditions, or specialized processes and equipment encountered by employees that would require safety training, e.g., certification training, cryogenic liquid carrier driver or hazardous waste operations, etc.

(5) Identification and documentation of the planned training to be given to each employee category and the intended approach (course, literature, etc.). Refer to Appendix B for a suggested sample training schedule and career development plan.

(6) Determination of the availability of safety training resources. A lack of a specific training resource will require the development of specialized training course materials.

(7) Establishment of a training schedule (see Appendix B).

(8) Review, evaluation, and revision, if necessary.

b. Reporting. The Field Installation Safety Office will maintain a current copy of the Installation Safety Training Plan.

405 PERSONNEL SAFETY CERTIFICATION REQUIREMENTS FOR POTENTIALLY HAZARDOUS OPERATIONS AND MATERIALS

Many NASA operations involve hazardous or unusual chemicals, state-of-the-art technology, or inherent hazards to life, the environment, or property. People who perform or control hazardous operations or use or transport hazardous material must possess the necessary knowledge, skill, judgment, and physical ability (if specified in the job classification) to do the job safely, and be certified to do so. The following paragraphs prescribe personnel certification requirements.

a. Exclusions

(1) This paragraph does not apply to personnel engaged in skill operations that already require certification by quality assurance organizations, such as soldering, brazing, crimping, potting, etc., and to personnel performing inspections using dye penetrant, magnetic particle, ultrasonic, radiograph, and magnaflux, etc.

(2) Certification of equipment and facilities is not within the scope of this section but may be equally as important as personnel certification in relation to safety. Refer to other applicable chapters in this document for information concerning equipment and facilities certification.

(3) This chapter shall not be used as a justification for allowing hazardous duty payments, environmental differential pay, or premium pay, nor will the fact that a job qualifies for hazardous duty pay imply that it is covered by this chapter. It has always been NASA safety policy to make all operations as safe as possible, even potentially hazardous testing. For guidance on hazard duty pay differentials, refer to 5 CFR 532, "Prevailing Rate System," 5 CFR 550, "Administrative Personnel, Office of Personnel and Management," and the Federal Personnel Manual.

b. Hazardous Operations Requiring Safety Certification. Hazardous operation safety certification is required for those tasks that potentially have an immediate danger to the individual (death/injury to self) if not done correctly, or could create a danger to other individuals in the immediate area (death or injury), or are a danger to the environment. Detailed training and certifications requirements may be found in specific safety standards, e.g., NSS/GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment," or NSS 1740.XX, "NASA Safety Standard for Explosives, Propellants, and Pyrotechnics." Additional hazardous operation safety certification requirements can be designated by each Field Installation safety official or his/her designee, but must include the following as a minimum:

(1) Flight deck crew members (FAA licensing may not be sufficient).

(2) Firefighters.

(3) Propellant or Explosive users (when improper procedures will result in injury or damage).

(4) Propellant or Explosives handlers.

(5) Rescue personnel.

(6) Self-Contained Breathing Apparatus (SCBA) users.

(7) Self-Contained Underwater Breathing Apparatus (SCUBA) users.

(8) High-voltage electricians (above 500 V).

(9) Altitude chamber operators.

(10) High-pressure liquid/vapor/gas system operators (above 150 psig).

(11) Hyperbaric chamber operators.

(12) Tank farm workers.

(13) Wind tunnel operators.

(14) Welders.

(15) Laser operators/maintenance personnel.

(16) Centrifuge operators.

(17) Range Safety Officers.

(18) Crane operators.

(19) Riggers for hoisting operations.

(20) Heavy equipment operators.

(21) Confined space entry personnel.

c. Hazardous Materials Handlers Certification. This safety certification is required for those individuals involved strictly with the handling, transport, or packaging of hazardous materials that will not otherwise disturb the integrity of the basic, properly packaged, shipping container that holds the hazardous material. Operations that involve the reduction of palletized or otherwise combined items of packaged hazardous materials qualify as handling.

406 CERTIFICATION REQUIREMENTS

All personnel engaged in potentially hazardous operations or hazardous material handling, as determined by line management or Field Installation Safety Officials, will be certified as capable to operate the equipment or perform their jobs in a safe manner. All contractor personnel engaged in potentially hazardous operations or hazardous material handling shall fulfill these requirements as required in paragraph 203f.

a. For hazardous operation's certification, the following is required as a minimum:

(1) Physical examination (see subparagraph c).

(2) Initial training (classroom and/or on-the-job). The level of training will be determined and structured according to the hazards of the job being performed.

(4) Written examination (as needed).

(5) Periodic refresher training needs as determined by the Installation Safety Official, including review of emergency response procedures.

(6) The recertification period will be determined by the Field Installation Safety Official, but shall not exceed a 4-year interval.

b. For hazardous material handlers, the following is required as a minimum for certification:

(1) Specific training in the Federal, NASA, and local rules for preparing, packaging, marking, transporting hazardous material and/or equipment operation associated with the job. Drivers or operators of vehicles transporting hazardous materials shall be instructed in the specific hazards of the cargo or material in their vehicle and the standard emergency and first-aid procedures that should be followed in the event of a spill or exposure to the hazardous material. Training requirements can be found in 29 CFR 1910, "Code of Federal Regulations, Department of Labor (DoL), Occupational Safety and Health Standards," 40 CFR, and 49 CFR 177, "Code of Federal Regulations, Department of Transportation (DOT), Research and Special Programs Administration, Carriage by Public Highway." The risk of all hazardous chemicals produced or imported shall be evaluated. Information involving this risk must be transmitted to all employees in accordance with 29 CFR 1910.1200, "Hazard Communication," and NHS/IH-1845.3, "Hazard Communication."

(2) Written examination (as needed) to determine the adequacy and retention of the training.

(3) The recertification period will be as determined by the Field Installation Safety Officials in the absence of any local, state, or Federal requirements.

c. Unless otherwise specified, the need for physical examinations for hazardous operations jobs, either to determine fitness for duty or to assist in establishing baseline or occupational exposure levels, will be as determined by the cognizant health official and will be in compliance with the applicable codes, regulations, and standards covering the occupation or environment. The need for fitness-for-duty examinations should be based on the hazardous consequences of employee's inability to perform the job correctly due to physical or mental deficiencies.

d. Personnel who are hazardous-operations-safety-certified or hazardous-material-handler-certified will be identified through the issuance of a card or license (to be carried on person) or a listing on a personnel certification roster. The roster indicates name, date, materials or operations for which certification is valid, name of certifying official, and date of expiration.

This page intentionally left blank.

CHAPTER 5: NUCLEAR SAFETY FOR SPACE SYSTEMS

500 PURPOSE

This chapter provides policy and safety requirements to characterize and avoid unacceptable risks associated with the use of radioactive materials in space craft during normal or abnormal conditions, including launch aborts with uncontrolled return to Earth. This chapter also outlines NASA procedures and interagency review and approval requirements for the use of radioactive materials in spacecraft, unmanned launch vehicles, and the Space Shuttle Program (SSP). This chapter does not include procedures, requirements, or licensing details for using, storing, shipping, or handling radioactive materials in ground-based facilities or activities or in preparation for space uses.

501 POLICY

a. Use of radioactive materials shall not put spacecraft and/or launch vehicles, the general public, or the environment at unacceptable risk. NASA policy provides for separate procedures for small radiation sources flown in space, e.g., the small sources used in scientific instruments, and for larger systems like nuclear power sources.

b. Every nuclear-fueled electric or thermal power system that is being considered for use in a space application shall have a Safety Analysis Report (SAR) prepared by the lead Field Installation and NASA Program/Project Office. Because Department of Energy (DOE) regulations require a similar report for major sources, the Program/Project Office normally adopts the DOE report to fulfill this requirement. The SAR provides evidence that the radiological risks associated with the use of nuclear sources are commensurate with the benefit derived from the mission. As an integral part of the safety review process, a risk analysis shall be performed to assess quantitatively the potential human exposure to radiation, the probabilities of exposure for all phases of the proposed mission, and the potential for impacts on human health or the environment from exposure to radiation as a result of the mission.

c. All space flight equipment that contains or uses radioactive materials shall be identified and an analysis shall be performed and documented describing the degree of radiological risk. NASA policy requires that the basic designs of such systems provide protection to the users to levels As Low As Reasonably Achievable (ALARA). For systems produced for NASA by the DOE, ALARA protection will be a joint DOE/NASA responsibility. Injection of isotopes for flight investigations comes under the purview of the NASA Safety and Health organizations as do the dosimetry programs for ensuring that cumulative radiation exposures are tracked.

d. The Executive Office of the President, through the Office of Science and Technology Policy (OSTP), shall approve major radioactive sources used in space in accordance with Presidential Directive/NSC-25, "Scientific or Technological experiments With Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems Into Space." (The dividing line between major and minor sources is defined in the June 16, 1970, National Aeronautics and Space Council (NASC) report, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations.") Small radioactive sources may be approved by the NASA Coordinator for the Interagency Nuclear Safety Review Panel (INSRP) (see subparagraph g). However, small source approval must be documented in a quarterly Minor Radioactive Sources Report to OSTP. For Minor Radioactive Sources Report requirements, see paragraph 504b(1).

e. As part of the overall process for approval to launch spacecraft carrying significant quantities of radioactive material, an independent evaluation is required. At the center of this process is, as stated in PD/NSC-25, "An ad hoc Interagency Nuclear Safety Review Panel (INSRP), consisting of members from the Department of Defense (DoD), DOE, and NASA who will evaluate the risks associated with the mission and prepare a nuclear Safety Evaluation Report (SER)."

(1) INSRP is authorized to proceed with their evaluation after congressional approval of a NASA or DoD mission using nuclear materials as part of the experiments, spacecraft, or launch vehicle or when nuclear materials are selected for use on a mission. The INSRP is involved in the very early stages of mission development. The panel monitors activities related to the development of launch and mission accident and environment models and their probabilities of occurrences.

(2) The Coordinators are authorized by their agencies to obtain the necessary internal expertise to support INSRP in its nuclear safety evaluation. Funding shall be provided for any additional expertise required for this purpose as well. In addition to the panel Chairpersons, representatives from the Nuclear Regulatory Commission and Environmental Protection Agency (EPA) also may participate in the radiological risk assessment as observers.

(3) The three Panel Chairpersons shall be assisted in their evaluation effort by top technical experts working in subpanels comprising scientific and engineering specialists from a number of Government agencies, national laboratories, industry, and universities. These specialists attend program reviews, evaluate the analysis performed by the Program/Project Office, conduct independent studies and analyses, review designs, and examine results of test activities.

(4) The initial INSRP meeting is used to organize the subpanels and support specialists needed by the Coordinators to support the safety analysis review. The number and type of subpanels required to support the INSRP process will be determined by the INSRP as needed. The following subpanels are representative of those that have been formed by INSRP for nuclear-powered payload programs in the past:

(a) Launch Abort

(b) Reentry

(c) Power System

(d) Reactor Criticality and Operations (if needed)

(e) Meteorology

(f) Biomedical/Environmental Effects.

f. The Program Final Safety Analysis Report (FSAR) and the INSRP subpanel reports are the basic documents reviewed by the three INSRP Chairpersons in preparation for their Safety Evaluation of Risk (i.e., SER). The NASA Administrator will use this evaluation to request launch approval from the OSTP, Executive Office of the President.

g. NASA shall perform radiological contingency planning, on-site emergency response, and cleanup (if required as the result of Agency operations).

h. For international cooperative or reimbursable missions that involve nuclear power or radioactive sources, NASA shall seek and obtain, in the international agreement that establishes the joint project, an appropriate commitment by its international partner to provide and apply an equivalent degree of rigor in the process throughout the project to ensure public and environmental safety.

i. NASA is required to notify foreign governments, with whom exist formal agreements regarding emergency landing sites for the Space Shuttle, of any hazardous materials on each flight, including radioactive materials, and the specific handling procedures for such materials.

502 RESPONSIBILITIES

a. The NASA INSRP Coordinator/Chairperson:

(1) Is responsible for overall NASA participation during the INSRP review, including the generation of the SER.

(2) Reviews and approves all "small source" uses of radioactive materials by the Agency in space.

(3) Approves selection of the NASA members of the INSRP subpanels and requests support (travel, funding, technical, and test facilities as necessary) through the NASA Field Installation Directors or other sources.

(4) Interfaces with Program/Project personnel and provides guidance to ensure that INSRP requirements are understood and adequate information is provided to the panel for review.

(5) For NASA operations, provides specific guidance to the program for preparing necessary documentation for presentation to the INSRP at the various stages of the review. The level of detail required and the decision to waive certain requirements shall be made by the Chairperson in consultation, as necessary, with other INSRP Chairpersons and subpanel members.

b. The NASA Headquarters Office of Safety and Mission Assurance, working through the Federal Emergency Management Agency, will arrange support by the DOE and others as necessary to implement the activities of the Radiological Control Center described in subparagraph d(8).

c. Program/Project Offices shall:

(1) Confer with the NASA INSRP coordinator as soon as radioactive power units, heat sources, or other large sources are tentatively selected for use on NASA spacecraft.

(2) Identify and document the degree of radiological space flight risk of all equipment containing or using radioactive materials.

(3) Comply with pertinent directives, licenses, agreements, and requirements promulgated by NASA, DoD, DOE, Nuclear Regulatory Commission, and OSTP.

(4) Designate individuals to coordinate the nuclear safety development and documentation requirements with the suppliers (DOE, contractors, or in-house offices), the Nuclear Regulatory Commission, the supporting organization, and the INSRP Chairpersons.

(5) Prepare (or have prepared) and justify the mission SAR.

d. Field Installations. The following actions are the responsibility of the lead Field Installation, except where otherwise noted:

(1) Ensure that the use of radioactive material in spacecraft has been planned and designed to avoid injury and unacceptable radiation exposure during normal or abnormal conditions, including launch aborts with uncontrolled return to Earth.

* (2) Assess the potential risk from radioactive materials during on-site operations. The analysis shall trace the movements, handling, storage, and testing of the units from arrival at the Field Installation until launch.

(3) Provide quarterly Minor Radioactive Sources Reports to the NASA INSRP Coordinator for approval decision and for use in conveying all such information to OSTP. These reports shall be provided quarterly by each Field Installation.

NOTE: The following responsibilities are for major sources as defined in the June 16, 1970, NASC report, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations:"

(4) Verify that nuclear and radioactive materials comply with appropriate license requirements at the planned launch and landing sites. Radioactive materials shall be controlled and licensed unless they are very small sources as defined in the June 16, 1970, NASC report.

(5) Ensure that large nuclear power and heater units receive special handling in accordance with procedures approved by NASA and DOE. Installation of the units onto the spacecraft and/or transportation systems shall be controlled carefully, follow safeguards, and use updated emergency plans.

NOTE: The following actions are normally performed by the launch site Field Installation under the direction of the lead Field Installation.

(6) Conduct practice contingency response drills as required.

(7) Use the comprehensive radiological contingency plans developed to address all potential launch/landing accident scenarios.

* Primarily Occupational Health responsibility.

(8) Establish a Radiological Control Center manned with specialists from DoD, DOE, NASA, and other agencies as necessary, to provide technical support in the event of a mishap. The Center shall be manned during the immediate prelaunch phase, during launch, and during early mission operations whenever nuclear power or heater units are involved. Radiation monitoring teams, decontamination teams, and other specialists shall be included as appropriate.

(9) Execute special search efforts for the nuclear sources, in the event of ocean impact, as part of the range recovery operations. Underwater sound generators shall be included on or in the immediate proximity of the nuclear sources to aid in search efforts in the event of water impact.

(10) Provide for special off-site monitoring and cleanup teams if radioactive materials are released during an abort. Radiological Control Center personnel will coordinate the efforts of specialists from other agencies and contractors. However, the launch Installation shall have primary responsibility for all aspects of these launches unless and until specifically released from that responsibility by the NASA Administrator for some phases of cleanup (for example, if DOE accepted responsibility for directing off-site decontamination and cleanup).

e. Other Agencies. The following related responsibilities are non-NASA but are included here for clarity:

(1) DOE analyzes NASA-supplied, anticipated normal and launch vehicle failure modes and their resulting environments, and conducts tests to determine nuclear system survivability.

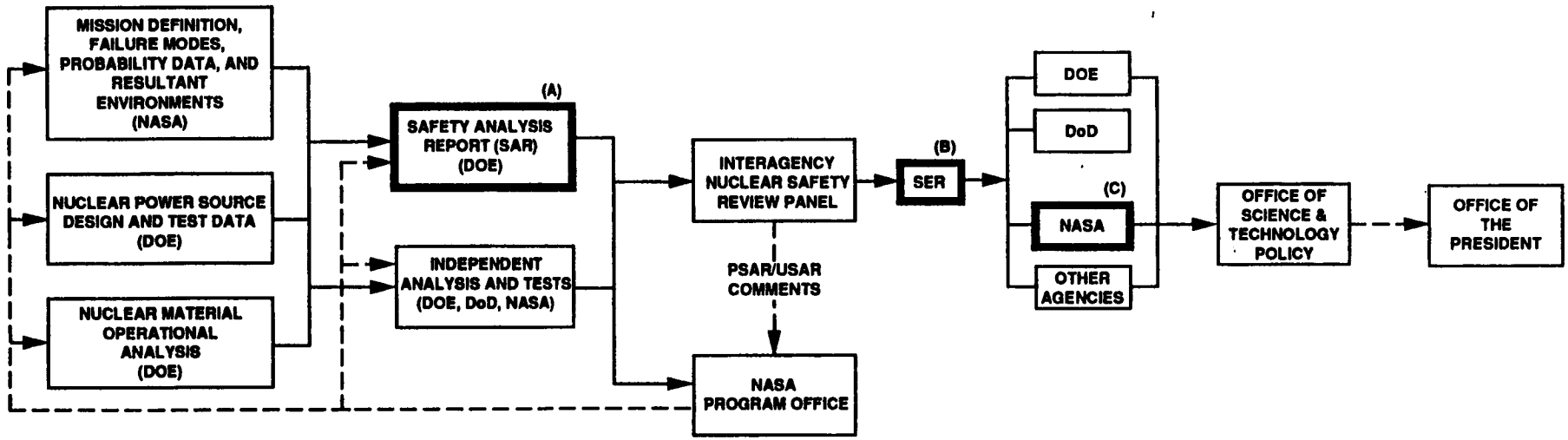
(2) DOE may supply the Mission Safety Analysis Report to be used by the NASA program.

(3) DOE has statutory responsibility for the safety of nuclear space power systems.

(4) DoD has range safety responsibility if the launch is from a DoD range.

503 THE SPACE NUCLEAR SAFETY REVIEW PROCESS

a. Nuclear Safety Process. Figure 500-1 depicts the space nuclear safety process for NASA missions. This process involves the following four major phases:



(A) PSAR = PRELIMINARY
USAR = UPDATED
FSAR = FINAL
} SAFETY ANALYSIS REPORT

(B) SER = SAFETY EVALUATION REPORT, BASED ON FSAR REVIEW.

(C) RESPONSIBLE MISSION AGENCY MUST MAKE LAUNCH RECOMMENDATION.

Figure 500-1. Space Nuclear Safety Review Process for NASA Missions

(1) Preparation of the SAR by DOE for the specific NASA project.

(2) Review of the SAR by the INSRP and issuance of the SER.

(3) Processing of the NASA launch approval request to the OSTP.

(4) Approval of the launch by the Executive Office of the President.

b. Process Phases. These process phases are described as follows:

(1) Safety Analysis Reports. The nuclear safety analyses required to define the radiological risks of a particular mission to people and the environment are consolidated into a set of summary documents collectively known as the SAR. The SAR's provide data for formal safety reviews and evaluation. Supporting data and analyses include a definition of the mission that is detailed enough to permit determination of potential failure modes, the associated probabilities, and the environments that could result from these failures. In addition, the final SAR (i.e., FSAR) provides the analytical data to verify the radiological risks of the mission; the FSAR is, therefore, the basis used by the Program to obtain flight approval.

Three issues of the SAR are published for each mission — preliminary, updated, and final. The preliminary SAR (PSAR) is produced after the conceptual design of the nuclear power source. The PSAR includes preliminary information on the reference design including the mission, spacecraft, and launch vehicle. Also included are accident models and probabilities with a semi-quantitative evaluation of the nuclear power source response to the accident models.

The updated SAR (USAR) provides improved accident models, with their environment estimates, and the nuclear system response to these environments. The USAR also includes a first-cut risk assessment and approach and is normally issued at least 2 years prior to scheduled launch. The multiple-volume FSAR is normally issued 1 year prior to scheduled launch and concludes the program safety analysis process. It incorporates the final nuclear system design, accident models and probability estimates, environment estimates, and response of the system to the accident environments as verified during the course of the system development testing. The FSAR also includes the final radiological risk assessment including the uncertainties associated with the assessment.

(2) INSRP primarily acts as a review board for each SAR issue. The SAR's are distributed to the panel and subpanel members and the

sponsoring Program Office. A safety review is then held in which a summary of the SAR is presented to INSRP. At the conclusion of the various reviews, the INSRP Coordinators may issue recommendations for further analyses or tests to the NASA Program Office. After review of the FSAR, the INSRP will generate an SER (see Figure 500-1), which accompanies the Administrator's request for Presidential approval of the launch. The SER is normally completed at least 5 months prior to scheduled launch to allow 2 months for Agency study and 3 months for OSTP review and decision.

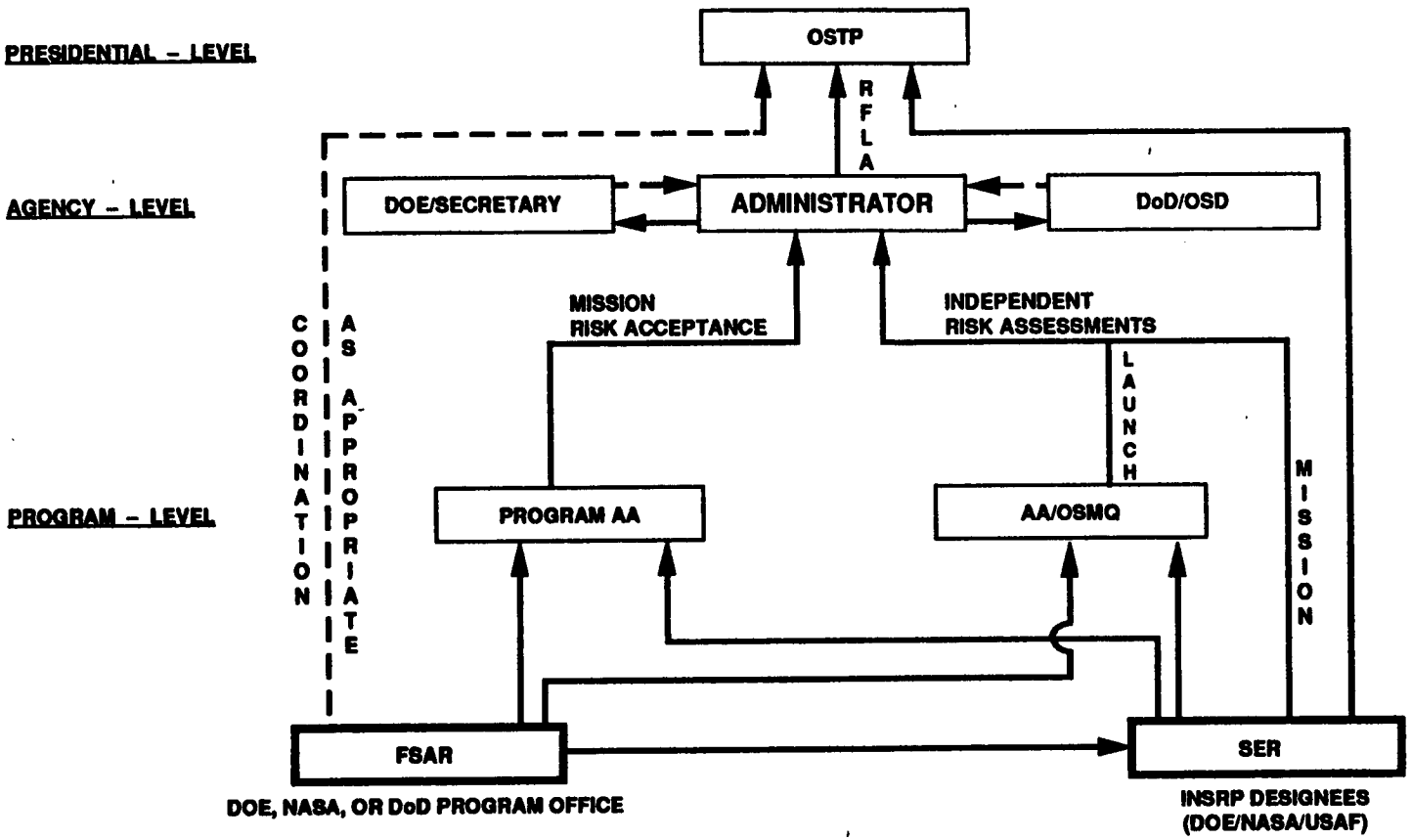
(3) Launch Approval. The NASA launch approval decision flow (Figure 500-2) includes the following major steps:

NOTE: For DoD missions, in Figure 500-2, reverse NASA Administrator and DoD Assistant Secretary for Nuclear Energy.

(a) After review of the nuclear safety aspects of the mission, the INSRP Chairpersons issue an independent risk assessment in an SER. The risk assessment considers the potential human exposures to radiation, potential degradation of the environment, and the probabilities of exposure for all phases of the proposed mission. The SER is presented to Agency managers for their use in determining Agency risk benefit decisions. In the event of INSRP disagreement on the safety of the nuclear device, the dissenting INSRP Chairperson may write a separate minority report describing the areas of disagreement, for inclusion in the SER. The agencies will consider these differences before the request for approval is carried forward.

(b) The applicable Program Office shall schedule a Senior NASA Management Review with the Administrator to present the mission purpose and the justification for associated risk acceptance. This briefing is followed by another presentation by the INSRP Coordinator(s) to the Program and Agency head on the findings of their independent assessment that is formalized in the SER.

(c) In fulfillment of basic charter of the Office of Safety and Mission Assurance (SMA), the sponsoring Program Office shall obtain concurrence from the AA for SMA on its request for launch approval submitted to the NASA Administrator. The basis of the AA's decision is data provided by the FSAR, SER, and other sources involved in the total launch process.



Safety Documentation: Final Safety Analyses Report (FSAR) – Develops Basic Data.
Safety Evaluation Report (SER) – Provides Independent Assessment.

RFLA: Request for Launch Approval.

Figure 500-2. NASA Launch Approval Decision Flow

(d) With concurrence of the other two agencies, implying their statutory responsibilities have been satisfied, the NASA Administrator will submit a request for launch approval to the OSTP. The formal request should contain, as attachments, the FSAR, SER, and a statement attesting that the proper launch contingency preparations have been made (refer to paragraphs 502d(6) through 502d(10)).

(e) OSTP requires a minimum of 90 days to review the material provided with the request for launch approval. OSTP normally sends a letter to the lead Agency announcing their decision to approve the launch subject to meeting the other mission and range requirements.

504 REPORT REQUIREMENTS

a. Major Radioactive Sources

(1) Environmental Impact Statement (EIS). The National Environmental Policy Act of 1969 (NEPA), as amended, is implemented by NASA through regulations contained in 14 CFR Subpart 1216.3. 14 CFR 1216.305(c) requires an EIS for all space missions that might carry substantial amounts of radiological materials as indicated in the June 16, 1970, NASC report, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations." The final EIS is normally completed early in the program, well in advance of any SAR's. It uses the best available information and should be circulated prior to the decision to proceed from the detailed planning/definition phase to the development/construction (or implementation) phase of the proposed action. Once completed and circulated, the final document is used by NASA to determine whether to continue design implementation, enter a redesign, select a nonradioactive alternative, or cancel the project.

(2) Safety Analysis Report. An SAR details accident models and the safety features of a mission using a particular nuclear system or source and a specific launch vehicle.

(a) Major heat sources and nuclear power sources for space (as defined in the NASC report of June 16, 1970) require an SAR and extensive formal review by the INSRP.

(b) The Program/Project Office shall prepare (or have prepared) and justify the SAR.

(c) Requirements and guidelines for preparing SAR's are provided by the NASA INSRP Coordinator and include requirements for mission definition data, failure mode data, failure probability data, associated uncertainties, detailed guidelines, technical models, reference data, instructional materials, and other pertinent information.

(3) Safety Evaluation Report

(a) The INSRP prepares the SER, which details the radiological risk of a particular source or system based on the panel's independent assessment of the mission.

(b) The SER provides information to DoD, DOE, and NASA management to assist them in their decision to request launch approval; or if deemed necessary, to modify the program, mission, or system to further reduce risks. This report is also the basic summary document submitted to the OSTP by the sponsoring agency for its use in making the decision to approve or deny approval to proceed with the launch.

(4) Launch Approval Request. With concurrence of the other two agencies, the NASA Administrator will submit a request for launch approval to the OSTP. The formal letter should contain, as attachments, the FSAR, SER, and a statement attesting that the proper launch contingency preparations have been made (refer to paragraphs 502d(6) through 502d(10)).

b. Minor Radioactive Sources Report.

(1) Minor Radioactive Sources Report (as defined in the NASC report of June 16, 1970).

(a) The NASA INSRP Coordinator, after review of required safety information (i.e., SAR or EIS), has the authority to approve the launch of small sources and shall notify appropriate individuals and organizations with an appropriate letter and copies of the quarterly Minor Radioactive Sources Reports from each Installation.

(b) The Minor Radioactive Sources Report (Figure 500-3) shall include (preferably in tabular form): spacecraft, launch schedule, launch site, number of sources, isotopes, total activity, category, and remarks (e.g., orbit, duration, plans to recover sources, burnup, and other pertinent information).

QUARTERLY REPORT
MINOR RADIOACTIVE SOURCES

SPACECRAFT	LAUNCH DATE	LAUNCH SITE	NO. OF SOURCES	ISOTOPE	TOTAL ACTIVITY mCi	RADIO-TOXICITY CATEGORY GROUP	REMARKS (ORBIT DURATION, ETC.)

Figure 500-3. Minor Radioactive Sources Report

(2) Safety Analysis Summary (SAS). An SAS has less detail than the SAR, but is prepared and reviewed in a similar manner within NASA. The NASA INSRP coordinator may require an SAS to accompany a Minor Radioactive Sources Report.

(3) Environmental Assessment (EA). For space missions that might carry minor amounts of radiological materials as indicated in the June 16, 1970, NASC report, an EA is required in accordance with 14 CFR 1216.305(b). The EA must be completed prior to the decision to proceed from the conceptual study phase to the detailed planning/definition phase of the proposed project. Based on the EA, NASA shall either make a Finding of No Significant Impact (FONSI) or decide to prepare an EIS. The EA may also be used by NASA to undertake mitigative redesign of the project. For many individual missions (e.g., normal Space Shuttle payloads), there is already existing generic environmental documentation that fulfills this requirement.

CHAPTER 6: OPERATIONAL SAFETY

600 PURPOSE

This chapter establishes policies and safety requirements for NASA's Operational Safety program.

601 APPLICABILITY AND SCOPE

The policies and requirements of this chapter apply to all NASA organizations, programs, and facilities, and contractors in accordance with the terms of the contract.

602 OBJECTIVES

Operational safety directives are intended to protect flight, ground, laboratory, and underwater personnel; craft; payloads; the general public; public-private property; and the environment from operations-related safety hazards. This chapter is not inclusive of all regulations and requirements governing operations; therefore, references are indicated liberally throughout the text for detailed or working standards, specifications, and subject matter covered extensively elsewhere.

603 MOTOR VEHICLE SAFETY

Each Field Installation shall enact regulations that are in compliance with applicable Federal, State, and local motor vehicle safety regulations.

a. Motor Vehicle Operation

(1) Operators of motor vehicles shall not drive a motor vehicle for a continuous period of more than 10 hours, including non-NASA driving; nor shall the combined duty period exceed 12 hours in any 24-hour period, without at least 8 consecutive hours of rest. Variation in the above policy requires documented approval of the Field Installation's Safety Office.

(2) Every person regularly or occasionally operating a motor vehicle shall possess, at all times while operating such a vehicle, a valid state driver's license for the class of vehicle being operated. Every person who operates any vehicle that requires special licensing shall possess, at all times while operating such a vehicle, a locally prepared operating permit that shows name, date, vehicle for which permit is valid, signature of certifying official, and date of expiration.

(3) If operation of the vehicle involves skills beyond those associated with normal, everyday operation of private motor vehicles, formal initial training, consisting of both classroom and operational testing, shall be conducted to ensure operator proficiency. Refresher training and testing shall be accomplished periodically as determined by the Field Installation Safety Office.

b. Safety Belts. Safety belts shall be installed in all NASA owned and operated passenger cars, multipurpose passenger vehicles, trucks, and buses in accordance with the requirements of Executive Order 12566 and 49 CFR 571. The number of occupants in a NASA vehicle is limited to vehicle-rated occupancy.

(1) Children unable to use the safety belts shall be secured in DOT-approved child safety seats.

(2) Under the following conditions, the use of installed belts is not mandatory:

(a) The individual possesses a written indication from a physician that he/she is unable to wear a safety seat or shoulder belt for medical or physical reasons.

(b) The use of the safety seat or shoulder belt would interfere with operation of the vehicle or mission of passengers (e.g., emergency response, special purpose vehicle, etc.) and is so certified by the Field Installation Safety Office.

(3) NASA motor vehicles (including pickup trucks, other trucks with a flatbed and sides) or special purpose equipment (fire trucks, scape trucks) will not carry passengers in the cargo area unless designated occupant positions are provided (see 49 CFR 571.207) and required safety belts are installed.

(4) All occupants of motor vehicles operated on NASA property (including delivery vans and trucks of all sizes), whose seat is equipped with a safety belt, will have the safety belt properly fastened at all times when the vehicle is in motion.

c. Maintenance and Inspection

(1) All Field Installation NASA motor vehicles shall be given an annual motor vehicle safety inspection, and when appropriate, an emission control system inspection by qualified personnel. Vehicles shall be checked to ensure that equipment and accessories are in safe operating condition and free of apparent damage that could cause failure while in use. These requirements also shall apply to

equipment such as lights, reflectors, windshield wipers, defrosters, and fire extinguishers where such equipment is necessary. Written inspection and maintenance records shall be maintained by the local logistics/vehicle management office.

(2) All NASA motor vehicles in use, off government property, shall be inspected to the standards of the State or other jurisdiction's vehicle safety inspection requirements. This inspection is to be accomplished by the NASA facility or by a certified jurisdictional inspection facility.

(3) Prior to initial checkout of a government-contracted or rental vehicle for use, the operator should inspect the vehicle for obvious defects, damage, or nonfunctional systems, e.g., brakes, head/tail lights, wipers, horn, etc.

d. Offenders. Field Installations are authorized to take disciplinary actions under the provisions of NMI 3752.1, "Delegation of Authority To Take Disciplinary and Adverse Actions."

e. Traffic Control Devices and Markings. American National Standard Institute (ANSI) D6.1, "Manual on Uniform Traffic Control Devices for Streets and Highways," shall be used for guidance when setting traffic control devices or marking roads for motor vehicle operations on NASA property.

604 PROTECTIVE CLOTHING AND EQUIPMENT *

a. General. Protective Clothing and Equipment (PCE) shall be issued to NASA employees at government expense in those situations where engineering controls, management controls, or other corrective actions have not reduced the hazard to an acceptable level or where use of engineering controls, management controls, or other techniques are not feasible.

b. Procurement.

(1) Directors of Field Installations and the Director, Headquarters Administration Division, are authorized to purchase PCE after the purchase request has been reviewed by safety and health professionals to determine proper specifications and adequacy of abatement. It is recommended that local safety and health committees be involved in the decision.

* Joint Safety and Health responsibility.

(2) The authority for the purchase of PCE with appropriated funds is Public Law 97-258, 5 U.S.C. 7903, "Protective Clothing and Equipment" (September 13, 1982, 96 Stat.1063).

(3) Only clothing and equipment meeting Federal regulations or industrial standards shall be used.

c. Issuance.

(1) PCE shall be issued to all NASA employees exposed to hazards in accordance with subparagraph a. Accountability shall be in accordance with NHB 4200.1, "NASA Equipment Management Manual." Transients or visitors may be furnished PCE on a temporary basis if they are on site for NASA related business purposes or at NASA's invitation. The host, guide, or area supervisor shall be responsible for obtaining, issuing, and recovering the PCE. Other non-NASA, contractor, and noncontractor personnel must procure their own PCE to provide an equivalent level of safety as required by NASA except as noted of paragraph 203c.

(2) PCE shall be provided, used, stored, and maintained in accordance with 29 CFR 1910.132 through 1910.137 and stocked and issued as specifically directed in NHB 4100.1, "NASA Materials Inventory Management Manual."

d. Examples of PCE. Items which may be purchased and issued by NASA include, but are not limited to, the following:

(1) Safety goggles and safety spectacles (plan and prescription).

(2) Welding helmets and shields.

(3) Safety shoes.

(4) Steel sole and/or toe safety boots.

(5) Aprons, suits, and gloves (e.g., fire resistant materials, leather, rubber, cotton, synthetics).

(6) Protective head gear (e.g., hard hats and caps, liners, helmets, and hoods).

(7) Barricades, traffic cones, flags, scaffolds, warning signs, alarms, lights, shields, and other public protective devices.

(8) Face shields.

(9) Specialty items of protective nature (e.g., cryogenic handlers suits, metallic and/or reflective fire fighter suits, foul weather gear, harnesses, life belts, lifelines, life nets, insulated clothing for "cold test" exposure, supplied air suits, and electrical protective devices).

(10) Concentration alarms, toxic gas indicators, explosive gas indicators.

e. Health Related PCE. Guidance for purchasing respiratory protective devices and other health-related PCE shall be issued by the NASA Occupational Health Office.

605 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT PROGRAM)

It is NASA's policy to meet or exceed OSHA's minimum performance requirements for the control of hazardous energy as outlined in 29 CFR 1910.147. All NASA Field Installations shall establish a program for controlling hazardous energy during service and maintenance operations where the unexpected energizing or startup of equipment could cause injury to employees or equipment damage. The Installation programs shall comply with all aspects of 29 CFR 1910.147 and to electrical, pressure, hydraulic, pneumatic, and mechanical systems as a minimum. See paragraphs 609, 610, 611, and 616 for further information.

606 PRESSURE AND VACUUM SYSTEMS SAFETY

NASA's program for ensuring the structural integrity of pressure vessels and pressurized systems (PV/S) and minimizing the associated mishap potential is outlined in NMI 1710.3, "Safety Program for Pressure Vessels and Pressurized Systems." This NMI assigns responsibilities for the various aspects of the program; references the codes, standards, guides, and Federal regulations that must be followed; and establishes unique NASA requirements in areas such as certification/recertification, documentation, configuration management, and operator training/certification.

607 ELECTRICAL SAFETY

This paragraph provides directives for protecting persons and property from electrical hazards. It applies to all NASA uses of electrical power.

a. Hazards. Electrical systems shall be designed (in accordance with MIL-STD 454, "Standard General Requirements for Electronic Equipment"), operated, and maintained to adequately control hazards that are likely to cause death or serious physical harm or severe system damage. Electrical equipment and associated wiring shall comply with applicable regulations, consensus codes, and standards. All electrical systems shall be reviewed by the Field Installation's Safety Office, not only for appropriate location but also in regard to proximity of ignitible or combustible properties of material such as gas, vapor, dust, or fiber.

b. Requirements

(1) All work shall be performed by personnel familiar with electrical code requirements and qualified/certified for the class of work.

(2) Before work is begun, the person in charge shall ascertain by inquiry, direct observation, or instruments, whether any part of an electric power circuit, exposed or concealed, is located so that the performance of the work may bring any person, tool, or machine into physical or electrical contact.

(3) Whenever possible, before repair work is begun, all equipment as well as circuits shall be de-energized and tested and personnel protected by lockout/tagout procedures.

(4) Supervisors shall ensure that no person works alone with electricity in excess of 600 volts. One person, trained to recognize the electrical hazards, shall be delegated to watch the movements of the other working personnel to warn them if they get dangerously close to live conductors or perform unsafe acts and to assist in the event of an accident.

(5) Transformer banks or high-voltage equipment (600+ volts) shall be protected by an enclosure to prevent unauthorized access. Metallic enclosures shall be grounded. Entrances not under constant observation shall be kept locked. Signs warning of high voltage and prohibiting unauthorized entrance shall be posted at entrances and on the perimeter of the enclosure. An authorized access list of qualified personnel shall be maintained.

(6) Where ESD is a significant hazard to personnel or hardware, conductive floors or other methods will be used.

c. Training. All persons engaged in electrical work shall be instructed in accident prevention and fully informed of the hazards involved. They shall be trained in first-aid procedures that should include Cardiac Pulmonary Resuscitation (CPR). For further guidance on training, see Chapter 4.

d. Regulations, Conformance Codes, and Standards. The established regulations, conformance codes, and standards shall be followed. Conflicts shall be documented and details submitted to NASA Headquarters for resolution. General references are listed in Appendix A.

608 POTENTIALLY HAZARDOUS BATTERIES AND CELLS

This paragraph provides directives for protecting persons and property from potentially hazardous batteries and cells. Advances in battery and cell technology

offer increasingly higher power density and improved performance characteristics. With these advances, users have sometimes encountered unanticipated and undesirable characteristics that can adversely affect personnel safety and health as well as battery and cell operation. By applying past experience to various ground and space applications, the potential hazard of these batteries and cells can be controlled. The Engineering Division (Code QE) manages the battery technology Program. Lewis Research Center (LeRC) has been designated the lead Center. The Battery Steering Group, which comprises Field Center and Headquarters personnel, serves as the top policy review and requirements generating organization for NASA.

a. Design Certification. Potentially hazardous battery and cell designs will undergo a certification test program. This program will include rigorous inspection and testing under the most critical conditions and using reasonable margins and test samples. The certification of each cell and battery for each application and use should accompany the cell and battery at all times throughout all phases of testing and use. Specific off-limit testing may be necessary to demonstrate the safety of the application and the incorporation of reasonable margins.

b. Documentation. Background information and experience concerning potentially hazardous batteries and cells will be documented, maintained, and consulted to assure the state-of-the-art advances are integrated into procurement specifications and operating procedures. These data will be transferred as "lessons learned" to other organizations and Field Installations. The Field Installation safety organizations will serve as the clearinghouse for this information.

c. Requirements. Each new and existing flight or nonflight application of potentially hazardous batteries or cells will be reviewed by battery experts and safety, reliability, and quality assurance specialists who are independent of the user organization. The review will ensure that the use of the technology is warranted and cannot reasonably be accomplished with less hazardous batteries or cells, that the proper type of battery or cell has been selected for the intended application, and that the design incorporates reasonable failure tolerance features.

(1) Proven applications such as the use of small button type lithium cells for personal nonflight applications in watches and calculators are exempted from this requirement.

(2) Positive actions will be taken to ensure that a high degree of quality control is maintained in the continuing manufacture of hazardous battery and cell products.

(3) Battery or cell design will be to a two-failure tolerant criteria to be imposed only where immediate personal safety or mission success is

adversely affected or major property damage potential exceeds $1,000,000.

(4) Planning for the application of potentially hazardous batteries or cells will consider and include adequate time for the modification of facilities necessary to ensure the safe handling, storage, and utilization of the batteries or cells.

(5) Battery and cell disposal requirements will comply with the applicable Federal, State, and local regulations and manufacturer guidelines. Caution shall be exercised in all handling operations.

(6) Storage areas shall be temperature controlled and maintained in accordance with manufacturer's recommended limits. No other materials commodity shall be stored in the same area with cells or batteries. Smoking shall be strictly prohibited in the storage area with "No Smoking" signs prominently displayed.

d. Responsibilities. Field Installation Directors will establish adequate controls to ensure that programs and projects under their control and cognizance comply with these requirements.

NASA Reference Publication 1099, "Lithium/Sulfur Dioxide Cell and Battery Safety," provides additional guidance needed at the Field Installation level for control of hazards associated with the handling and storage of new battery and cell technology.

609 HAZARDOUS MATERIAL TRANSPORTATION, STORAGE, AND USE

* This paragraph provides directives for protecting persons and property during the transportation, storage, and use of hazardous materials. Every effort shall be made to ensure complete safety and compliance with applicable Federal, State, and local laws and regulations. Hazardous material is defined by law as "a substance or materials in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce" (49 CFR 171.8). The Secretary of Transportation has developed a list of hazardous materials that are found in 49 CFR 172.101. At a minimum, the Federal regulations (e.g., DOT, EPA, OSHA) for transport of hazardous materials on both Federal property and public roadways shall be met. Typical hazardous materials are those that may be highly reactive, poisonous, explosive, flammable, combustible, corrosive, radioactive; produce contamination or pollution of the environment; or cause adverse health effects or unsafe conditions. For moredetailed requirements, see NHS/IH-1845.3, "Hazard Communication," and NHS/IH-1845.5, "Occupational Exposure to Hazardous Chemicals in Laboratories."

* Joint Safety and Health responsibility.

a. Transporting Hazardous Material

(1) NASA policy is contained in NMI 6000.5, "Transportation Management," which states that all hazardous material shall be transported by a certified contractor.

(2) All contractor motor vehicles, rail cars, boats, and ships covered by NASA Bill of Lading and used for transportation of hazardous material shall be inspected prior to loading to ensure that the vehicle is in safe mechanical condition. The mode of transportation shall be inspected to the applicable standards of the Federal Highway Administration, U.S. Coast Guard, Department of Transportation, and Federal Railroad Administration. All vehicles transporting hazardous materials on NASA and public roadways shall display all DOT-required placards, lettering, or numbering.

(3) Hazardous material as defined in 49 CFR 171.8 shall not be transported in NASA administrative aircraft. To ensure hazardous material is not inadvertently loaded on administrative aircraft, all cargo for shipment should be routed through the Field Installation's transportation office or, if enroute, cargo should be accepted only from a certified shipper or freight forwarding agency.

b. Storage and Use. Storage and use should, as a minimum, comply with State regulations and address the requirements for release prevention, control, countermeasures, contingency planning, and a listing of restricted/prohibited materials for purchasing and use at Field Installations. Periodic (at least annual) inventorying should be required; conditions of materials in storage should be assessed frequently (at least monthly).

610 HAZARDOUS OPERATIONS

* NASA hazardous operations involve materials or equipment that have a high potential to result in loss of life, serious injury to personnel, or damage to systems, equipment, or facilities (e.g., laboratory operations, high-pressure gas operations in excess of 150 pounds per square inch gage (psig), low-pressure high-volume gas operations, voltages above 600 volts, storage or handling of propellants or explosives, use of "heavy lift" material handling equipment, extreme temperature environments, environments with less than 19.5 percent or more than 25 percent oxygen by volume at normal atmospheric temperature and pressure, forced variations in gravity, etc.). Adequate preparation and strict adherence to operating procedures can prevent most of these mishaps. Each Installation/program will provide the following actions for hazardous operations:

* Joint Safety and Health responsibility.

a. Identification. Identify those operations that are considered to have the potential of being extremely hazardous.

b. Assessment/Analysis. Assess and analyze all potentially hazardous operations to determine risk to personnel, equipment, and facilities. Where a serious degree of risk dictates, personnel shall work in pairs (buddy system). Use analysis techniques as provided in Appendix H, where applicable.

c. Control. Eliminate or control hazards using the steps provided in paragraph 102. In general, all hazardous operations shall require Hazardous Operating Procedures (HOP's) or a hazardous operating permit. See Appendix I for assistance in development of HOP's.

(1) Hazardous procedures shall be so marked conspicuously on the title page to alert operators that strict adherence to the procedural steps and safety and health precautions contained therein is required to ensure the safety and health of personnel and equipment.

(2) All HOP's shall have an approval signature to certify that a review has been performed by the cognizant NASA or contractor safety or health representative(s) as applicable. Deviations or changes to HOP's also require the approval of the cognizant NASA or contractor safety or health office. Field Installation HOP development guidelines will include the requirement that line management concur with the proposed HOP. If approved by the contractor, a copy should be forwarded to the appropriate local NASA office for informational purposes.

d. Personnel Certification. Certification of people who perform or control hazardous operations or use or transport hazardous material must ensure that the individuals possess the necessary knowledge, skill, judgment, and physical ability to do the job in a safe and healthful manner. See Chapter 4 for Hazardous Operations Safety Certification.

611 LABORATORY HAZARDS

* This paragraph provides directives for protecting persons and property in a laboratory environment. For the purposes of this document, a laboratory is a facility in which experimentation, testing, and analysis is performed on human subjects, organisms, biological and other physical materials, substances, and equipment (including bioinstrumentation). Included also are certain equipment, repair, and calibration operations, and processing of materials.

* Joint Safety and Health responsibility.

a. Design Requirements

(1) Design of laboratories shall incorporate the requirements of the applicable State and Federal codes required for the individual Field Installation, e.g., building, electrical, fire protection for laboratory facilities. Escape routes shall be provided, designed, and marked in accordance with the National Fire Protection Association (NFPA) 101, "Life Safety Code." Occupational safety and health considerations such as ventilation, shower stalls, and eye wash stations shall be included in the design where applicable. For facility acquisition/construction safety, see Chapter 8.

(2) Areas with significant quantities of flammable, combustible, corrosive, and toxic liquids, solids, or gases shall be protected in accordance with the applicable provisions of NFPA 45, "Fire Protection for Laboratories Using Chemicals," as modified below. Laboratories not using or fitting the above chemical classification, yet housing unique, mission-critical, or high-value research equipment, shall conform to the provisions of NHB 1700.1(V9), "NASA Safety Manual - Fire Protection."

(3) Special facilities to ensure the integrity of both terrestrial environments and biological samples returned from space shall be considered in the design of the laboratory.

(4) Additional considerations shall be the biohazards resulting from use or handling of biological materials such as infectious micro-organisms, viruses, medical waste, or genetically engineered organisms. See OSHA Standard 29 CFR 1910.1030, "Bloodborne Pathogens," for additional details.

b. Electrical. For electrical safety requirements, see paragraph 607.

c. Energy Storage. Any experiment involving storage of energy (e.g., electrical, chemical, mechanical) shall be reviewed for potential hazards prior to its use during the design stage.

d. Chemical and Hazardous Materials. In addition to pertinent safety requirements found elsewhere in this document, the following requirements are specifically applicable to laboratories:

(1) All laboratories shall be operated in accordance with chemical hygiene plans as required by 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"; NHS/IH-1845.5; and NHS/IH-1845.3.

(2) Suitable facilities for quick drenching or flushing of the eyes and body of any person exposed to injurious corrosive materials shall be provided within the work area for immediate emergency use.

e. Mechanical

(1) Only qualified/certified personnel shall operate machines. Machine shop safety and practice shall comply with OSHA Regulations 29 CFR 1910 Subpart O, "Machinery and Machine Guarding."

(2) Lifting Devices and Equipment. All lifting equipment shall be operated and maintained in accordance with NSS/GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment."

f. Solar Simulators. While in direct view of a bare (pressurized arc) lamp, whether energized or not, that is not locked out or tagged out for maintenance or repair, all personnel shall wear skin and eye protection.

g. Ventilation. This is primarily an Occupational Health responsibility. See NHB 7320.2, "Laboratory and Industrial Ventilation," and NMI 1800.4, "NASA Occupational Health Program."

h. Glassware. Because some laboratory operations use a considerable amount of glassware and ceramics, necessary safeguards shall be employed to minimize personnel injury. Refer to the Guide for Safety in the Chemical Laboratory, Manufacturing Chemists' Association, Inc., "Handling Glassware."

612 LIFTING SAFETY

NASA's primary program for protecting persons and property during lifting operations is outlined in NSS/GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment." The NSS establishes minimum safety requirements for the design, testing, inspection, personnel certification, maintenance, and use of overhead and gantry cranes, mobile cranes, derricks, hoists, special hoist-supported personnel lifting devices, Hydrasets, hooks, and slings. The standard is a compilation of pertinent requirements from OSHA, ANSI, Crane Manufacturers Association of America (CMAA), and unique NASA requirements. Compliance with NSS/GO-1740.9 is mandatory for all NASA-owned and NASA contractor-supplied equipment used in support of NASA operations at NASA Installations. The individual Field Installation safety organizations are responsible for implementation and enforcement. For lifting devices and equipment not covered by NSS/GO-1740.9 (e.g., forklifts, A-frames floor jacks, aerial buckets, etc.), it is NASA's policy to follow standard industry/manufacturer recommended practices and applicable Federal, State, and local government regulations.

613 EXPLOSIVE AND PROPELLANT SAFETY

Proposed NSS 1740.XX, "NASA Safety Standard for Explosives, Propellants, and Pyrotechnics," will provide minimum safety requirements for developing explosive safety programs/directives. This document provides standards for protecting persons and property from hazards of explosives and explosive materials, including all types of explosives, propellants (liquid and solid), oxidizers, and pyrotechnic devices and supplements those requirements outlined in NHB 2710.1, "NASA Safety and Health Handbook." Explosive, propellant, and pyrotechnic operations shall be conducted in a manner that exposes the minimum number of people to the smallest quantity of explosives for the shortest period of time consistent with the operation being conducted.

614 UNDERWATER OPERATIONS SAFETY

NSS/WS-1740.10, "Underwater Facility and Non-open Water Operations," shall be used as the minimum standard to establish the safety requirements for all NASA neutral buoyancy facilities, equipment, personnel, and operations involving underwater activities that provide simulation of a weightless environment. This standard also applies to non-NASA facilities where NASA personnel shall participate.

615 LAUNCH VEHICLE AND SPACECRAFT OPERATIONS SAFETY

This paragraph provides policy and requirements for minimizing the risk to the public, operations personnel (including flight crews), public property, and Government property during launch vehicle (missile) and spacecraft launch and flight operations. It also covers the subjects of NASA Headquarters Safety representatives, Range Safety, Spacecraft Safety, and Space Debris Safety.

a. Risk. This includes the risk of injury or damage from:

(1) Hazards due to falling missile parts/debris from an errant missile or an aborted/flight-terminated missile during launch operations.

(2) Hazards due to falling missile parts/debris from a normally operating missile (staging, booster separation, etc.).

(3) Hazards due to reentering missile/spacecraft parts and/or debris.

(4) Hazards to spacecraft and especially spacecraft crews due to high or hyper-velocity impact with space debris.

b. NASA Headquarters Safety Representatives. A NASA Headquarters safety representative supports each launch of a NASA-managed launch vehicle, including orbital, manned/unmanned; major suborbital; and other vehicles as determined by the Associate Administrator for Safety and

Mission Assurance (SMA). These representatives monitor the preparations of each NASA launch vehicle and NASA payload for flight, evaluate the readiness of the vehicle and payload, and provide the appropriate NASA manager a concurrence or nonconcurrence on the readiness of the vehicle and payload to begin launch and flight operations. The representatives are assigned a position on the launch operations communications network and are responsible for determining the NASA Headquarters Safety concurrence with the readiness of the integrated launch system (vehicle, payload, and range support) for launch and communicating that status to the appropriate person on the network. (For Space Shuttle launches, the representative is assigned the call sign "Headquarters Safety" and provides the concurrence status to the senior program SMA manager, who is also on the network.) For other launches, the function can be delegated to a senior safety official at the launch site.

c. Range Safety. This subparagraph provides requirements for Range Safety, which includes launches for which there is a NASA involvement. It includes, but is not limited to, launches from a NASA range, using a NASA payload, a NASA-contracted launch vehicle, or NASA funds, or involving NASA on an advisory basis.

(1) National Ranges

(a) NASA space launches are conducted from three national ranges: the Eastern Test Range (ETR) and Western Test Range (WTR) operated by the DoD, and the Wallops Flight Facility (WFF) operated by NASA.

(b) Policy, requirements, and procedures to ensure the safety of personnel, facilities, and equipment placed at risk during operations on these ranges are delineated in the respective range safety requirements documents: Eastern Space and Missile Center Regulation (ESMCR) 127-1 for ETR; Western Space and Missile Center Regulation (WSMCR) 127-1 for WTR; KHB 1700.7, "STS Payload Ground Safety Handbook," for KSC; and GHB 1771.1, "Range Safety," for WFF. The responsibilities of ESMC and NASA for launches from the Kennedy Space Center have been defined by a Joint Operating Support Agreement.

(c) This agreement assigns responsibility for all in-flight safety to ESMC, ground safety at Cape Canaveral Air Force Station to ESMC, and Kennedy Space Center ground safety to NASA. Vandenberg Air Force Base, the host base for WTR, is responsible for all missile and ground safety.

(d) NASA aircraft and other test operations may be conducted at the ETR, WTR, or other national ranges such as White Sands Missile Range (WSMR), Wallops Flight Facility (WFF), Air Force Flight Test Center (AFFTC), and Eglin Test Range. For these ranges, the Range Safety policy, requirements, and procedures as delineated in the respective host range safety documents (e.g., ESMCR 127-1) shall be followed.

(e) Test Centers such as El Centro Test Flight Center, Dryden Flight Research Center, and other ranges, centers, and fields used for testing will be contacted to determine appropriate requirements for the test project planned.

(f) Launches conducted at non-NASA ranges shall comply with that range's policies; however, the criteria of this section shall be considered the minimum requirements for safe operations by range users, NASA personnel, and NASA contractors. When range requirements conflict, the most stringent requirement shall dominate.

(2) Field Installations

(a) The Field Installation responsible for coordinating the NASA participation in the launch operation shall ensure conduct of a coordinated range safety effort. The Field Installation also ensures that the hazards associated with the launch of space vehicles and test articles in which NASA has a direct interest or involvement are eliminated or minimized. This includes all safety activities from design through test, launch, vehicle flight, and recovery.

(b) The Field Installation is responsible for ensuring that prior to approval for payload processing and host vehicle launch from either the ETR or WTR, the user shall submit to the appropriate Range Safety Office (RSO), NASA Headquarters Safety and Risk Management Division, NASA (Sponsor) Field Installations, and the Launch Vehicle Program, a comprehensive safety data package that addresses the integrated payload and payload-to-launch vehicle interface(s) from both the flight and ground perspectives. Furthermore, the Field Installation shall coordinate with the user safety representatives, Headquarters Safety and Risk Management Division, NASA (Sponsor) Field Installations, Launch Vehicle Program, and Launch Site a safety review of the data package to assist NASA in the reduction of risk.

(c) Field Installations shall comply with established national range policy, requirements, and procedures.

(d) Field Installations are responsible for ensuring the safety of NASA personnel and resources and minimizing risks to the general public (personnel and property).

(3) Launch Contractor. For commercial ventures funded by NASA or with a NASA payload, the launch contractor is responsible for ensuring that a proper safety program is conducted. NASA representatives will oversee the vehicle preparation and launch operations as outlined in the NASA Headquarters commercial launch vehicle policy.

(4) Range Safety Officer. Each Field Installation responsible for a launching range will designate a Range Safety Officer. The Range Safety Officer shall protect the general public and public property from harm or damage resulting from the debris or impact of hazardous components from an errant vehicle (stage) or catastrophic flight. To carry out this mission, the Officer shall use and certify the operation and maintenance of the Range Safety System that is comprised of a range safety display system, range clearance capability, radar, optic and telemetry tracking, and display systems, and may include command control capability for a flight termination system. Although the risk associated with space-vehicle launches can never be eliminated completely, the Range Safety function is to minimize it while not unduly restricting the probability of mission success.

(5) Range Constraints and Requirements

(a) The geography, instrumentation, and problems of encroachment vary with each range facility. As a result, certain constraints are applicable to only that range. Further, different types of missiles and payloads may create other hazards and therefore require additional range constraints. Early program planning shall accommodate these constraints.

(b) All ranges have a formal system to plan and document the support required by each range user for each test or operation. The range user, i.e., NASA, is required to identify, well in advance, the type and extent of support required, such as telemetry, data processing, metric tracking, Telemetry Inertial Guidance (TMIG), and trajectory analysis. The lead time for identifying these requirements can be up to several years in those cases where additions or modifications to range equipment are required to meet the range user

(NASA) requirements. The designated Field Installation shall be responsible for identifying these support requirements and submitting the data necessary to properly define the interfaces on a timely basis. Advance planning and early interface with the range personnel are extremely important to avoid costly delays.

(6) Development and Operations Planning

(a) To reduce costly safety engineering changes to aerospace systems for operation at any range, Range Safety personnel shall be involved in the early concept stage of development and operations planning.

(b) The appropriate Field Installation shall notify NASA Headquarters and the designated Range Safety organization of all Preliminary Design Reviews (PDR's) and Critical Design Reviews (CDR's). NASA Headquarters and Range Safety personnel shall be invited and should attend PDR's and CDR's that involve safety-critical systems or operations that could affect range safety for both launch vehicles and payloads as appropriate.

NOTE: Each Program Manager must ensure adequate funding is made available to support this requirement.

(c) Written procedures shall be provided to Range Safety covering all operations conducted on the range.

(d) The Field Installation shall instruct the contractor to design, fabricate, and operate the end item so that it conforms to the range requirements contained in the appropriate range manual.

(7) Reviews and Audits. Each Field Installation that represents NASA as a range user shall provide sufficient and adequate safety documentation for NASA Headquarters safety reviews. The documentation shall include vehicle and payload descriptions, range requirement and compliance documents [Accident Risk Assessment Report (ARAR) and Missile Systems Prelaunch Safety Package (MSPSP)], flight plan, missile system prelaunch operation plan, descriptions [Flight Test Requirement (FTR)] of flight termination system, descriptions of radionuclide, and any waiver requests to known range safety requirements. Submittal of all documentation shall allow sufficient lead time for a complete review prior to launch. The Balloon and Sounding Rocket program is not included

in the NASA Headquarters review unless specific requests for information are requested.

(8) Mishap Reporting and Investigation. To ensure proper mishap investigation, each program/project office shall prepare a pre-mishap (contingency) plan. For policy on Mishap Reporting and Investigation, see Chapter 10.

d. Space Debris Safety. The NASA safety policy for space debris is contained in NMI 1700.8, "Policy for Limiting Orbital Debris Generation." This policy requires each program involved in spacecraft launch and/or deployment to formally assess and minimize the potential for generation of orbital debris.

616 BOILER SAFETY

This paragraph provides directives for the protection of persons and property through the periodic inspection of boilers.

a. Standards. Uniform procedures for testing and inspecting boilers are provided by the standards in the "American Society of Mechanical Engineers - Boiler and Pressure Vessels Code."

b. Inspections. Each boiler, covered by the code in the previous paragraph, shall be inspected annually by a competent agent who is independent of the organization providing maintenance. Inspections shall be accomplished by the state or municipal inspectors whenever possible.

617 ELEVATOR SAFETY

This paragraph provides directives for the protection of persons and property through the periodic inspection of elevators.

a. Standards. Uniform procedures for periodic inspection of elevators are located in the ANSI A17.1-65/A17.1-1967, "Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks."

b. Inspections. Each elevator shall be inspected annually by a competent agent who is independent of the organization providing maintenance. These independent inspections shall be accomplished by the State or municipal inspectors whenever possible.

618 TEST SAFETY

This paragraph provides directives for protecting persons and property during test operations, both manned and unmanned. Testing also includes hazardous training activities and demonstrations of test hardware or procedures. The requirements stated herein apply to test facilities; test equipment located within, or attached to, test facilities; equipment being tested; test personnel; test conduct; and test documents. Additional policy and requirements are detailed in Chapters 1 and 3, and other paragraphs of this chapter.

a. Test Plans shall be evaluated to ensure test performance within safe operating limits. Evaluations will address the test article, test facility, operator involvement, test conditions, potential risk to adjoining facilities and personnel, etc.

b. Safety Documentation establishes the basis for safe test conduct by means of engineering analyses (including hazard analyses calculations). Established test controls will be clearly identified in test drawings, facility drawings, test procedures, etc. The level of safety documentation required will be tailored to the risks involved with the test.

c. Test System Requirements

(1) Design test systems such that test personnel or critical test hardware are not subjected to a test environment wherein a credible single-point failure (e.g., power loss) could result in injury or loss to the critical test hardware.

(2) Construct all systems (electrical, mechanical, pneumatic, and/or hydraulic) so that no single failure could cause a critical condition.

(3) Ensure that software that may interface with test systems meets the requirements stated in Chapter 3. Software by itself is not hazardous; however, when interfaced with test hardware, software could command a hazardous condition in the hardware.

(4) Calibrate and certify safety-critical instrumentation before test operations and as required by test documentation or the test organization's internal procedures.

(5) Ensure all personnel involved in tests are informed of potential hazards, safety procedures, and protective measures.

(6) Ensure the availability of appropriate emergency medical treatment facilities.

(7) Conduct formal reviews of those engineering designs that are complicated or potentially hazardous to facilities.

(8) Ensure test reports include anomalies, safety implications, and lessons learned.

d. Test Readiness Review. Conduct Test Readiness Reviews for tests involving new or modified hardware and/or procedures. These reviews shall determine the safety, technical, and operational readiness of the test.

e. Pre-test Meeting. A pre-test meeting shall be held with all involved personnel that should include discussion of the research facility, design, instrumentation, safety, and operator training and certification, to establish the test plan, identify test constraints to ensure facility safety, and determine test article readiness.

f. Human Research Subjects. The requirements for the protection of human research subjects are contained in NMI 7100.8, "Protection of Human Research Subjects," and 45 CFR 46, "Protection of Human Subjects."

g. Manned Requirements. In addition to the requirements of subparagraph f, manned test systems shall meet the following criteria:

(1) Tests involving hazardous substances, where human test subjects or test team personnel may be exposed, will be reviewed for adequacy of test team safeguards.

(2) For tests requiring manned participation in a pressure suit, a facility environmental control system failure or failure in the distribution system affecting one pressure-suited occupant shall not affect any other pressure-suited occupant.

(3) A means shall exist of immediately detecting an incipient fire or other hazardous condition in each manned compartment of any test area. Automatic detection shall be provided for critical areas not suitable for visual monitoring.

(4) Manned test systems shall be designed for timely and unencumbered rescue of incapacitated test subjects.

(5) Software controlling manned test systems shall be thoroughly analyzed to ensure that no command could result in death or injury to the test subjects.

(6) Manned test systems shall be designed to provide for manual overrides of critical software commands to ensure the safety of test subjects during any system event or test scenario (normal operation, malfunction, emergency, etc.). Such overrides shall support safe test termination and egress of test subjects as appropriate.

619 NON-IONIZING RADIATION

* Microwave and radar protection standards are covered in various State regulations, national consensus, and Federal standards including 29 CFR 1910.97. This paragraph provides directives for protecting persons and property during laser use in NASA operations. The primary laser hazard to humans is eye and/or skin damage from direct exposure to the beam or specular reflection, and in some cases, viewing the diffuse reflection. Laser operations during any open-air laser scenario conducted on Department of Defense (DoD) controlled ranges or test facilities or by DoD personnel will use Document 316-91, "Laser Range Safety," for guidance. NASA's laser safety policy is discussed in the following subparagraphs.

a. Law and Compliance

(1) 21 CFR 1040 states that people shall not be exposed to laser radiation in excess of the maximum permissible limits. The array of possible physical controls is discussed in 21 CFR, State regulations, and ANSI standards.

(2) It is NASA's policy:

(a) To prevent exposure of personnel to laser radiation exceeding the permissible exposure levels. See subparagraph d(1).

(b) To ensure, to the maximum extent practical, the elimination of hazards to personnel from laser systems before they become operational and to develop procedures or equipment for those hazards that cannot be eliminated by engineering design.

(c) To procure or manufacture only laser products that comply with the performance standards of 21 CFR's 1040.10 and 1040.11, unless a specific exemption is obtained from the U.S. Department of Health and Human Services, Food and Drug Administration (FDA).

* Primary Occupational Health responsibility.

(d) To ensure that laser operation conforms to the principles and requirements set forth in ANSI Z136.1, "American National Standard for Safe Use of Laser" and ANSI Z136.2, "Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources."

(e) That any laser that can cause injury or damage must have a Field Installation approved safety permit, test plan, or test procedure review.

(f) That, where a planned lasing operation has the potential of the beam striking an orbiting craft, the Program Manager or designated Laser Radiation Safety Officer shall contact the Laser Safety Clearing House to obtain a "Site Window" clearance. The clearance is obtained from the Orbital Safety Officer, U.S. Space Command/J3SOO, 1 NORAD Road, Suite 9-101, Cheyenne Mountain AFB, CO 80914-6020, Stop 4, Phone: (719) 575-3510.

(g) That a qualified Laser Radiation Safety Officer shall review procedures for all tests that use lasers. An individual designated/approved by the Field Installation Safety organization will be on site to monitor all laser tests.

b. Ground Operations

(1) Class III-B and IV lasers shall:

(a) Be operated only in controlled environments or designated areas that:

i Have no unplanned reflective or transmitting surfaces and are equipped with emergency lighting fixtures.

ii Are posted with standard laser warning placards as set forth in ANSI Z136.1. During laser operations, the area shall be isolated from other areas to prevent inadvertent entry.

(b) Shall require laser goggles or other approved methods of eye protection in accordance with requirements of ANSI Z136.1.

(2) All flammable materials/vapors shall be kept away from any laser operational areas unless specifically authorized by operation/test plan.

c. Airborne Operations (Using Class III-B and IV lasers)

(1) Use of airborne lasers shall be identified early in the system acquisition process and tracked during the program life cycle. A realistic application of safety engineering to laser systems can avoid or reduce the costs involved in redesign, time lost in modification, and loss of mission capability. Program managers and safety evaluators shall assess the safety aspects, compliance with safety requirements, and resolution of laser safety-related problems.

(2) Design of laser systems for NASA aircraft and spacecraft shall prevent inadvertent laser output. However, a test circuit switch, protected from inadvertent operation, shall be provided to override the ground interlock to aid ground operation, maintenance, or service.

(3) The crew shall not operate the laser except in accordance with the prescribed mission profile. The craft commander shall ensure that the laser system is used in accordance with the test plan.

(4) For a long-distance laser shot, as large a hazard area as practical shall be selected to minimize the risk to the people outside the area. A buffer area should be added around the hazard area. Air Force AFOSH Standard 161-10, "Health Hazard Control for Laser Operations," includes a guide for operation of lasers from aircraft. It can be used to develop the buffer zone for space-based laser shots directed at the ground. Also see RCC Document 316-91, "Laser Range Safety," and subparagraph a(2)(f).

(5) A hazard evaluation and written safety precautions are essential prior to airborne laser operations. Hazard analysis shall consider catastrophic events and the need for very reliable, high-speed laser shutdown should such events occur. See ANSI Z136.1 for hazard evaluation and control information.

(6) Qualified personnel shall perform laser hazard evaluations to determine specific hazards associated with specific uses; establish appropriate hazard control measures; and identify crew and public-at-large protection requirements.

(7) A hazard evaluation shall consider the atmospheric effects of laser beam propagation, the transmission of laser radiation through intervening materials, the use of optical viewing aids, and resultant hazards, e.g., electrical, cryogenic, toxic vapors.

d. Software

(1) Software shall provide safety precautions for fast-moving lasers and prevent misdirected laser operation.

(2) Laser software development shall be subjected to a software safety analysis per Chapter 3. Existing systems are exempt but shall be reviewed to ensure the provision of safety precautions.

e. Training. Only trained and certified employees shall be assigned to install, adjust, and operate laser equipment. Personnel operating lasers shall be trained and certified in accordance with Chapter 4 of this manual.

620 CONFINED SPACES

The following provide the safety and health requirements for entry into confined spaces:

a. NASA Health Standard (NHS)/IH-1845.2, "Entry Into and Work in Confined Spaces," provides requirements to be followed in all NASA operations.

b. OSHA 29 CFR 1910.146, "Permit Required Confined Spaces," shall be used as a guide in all NASA operations.

c. American National Standards Institute (ANSI) Z117.1, "Safety Requirements for Confined Space."

d. NIOSH Publication No. 87-113, "A Guide to Safety in Confined Spaces."

CHAPTER 7: AVIATION SAFETY

700 PURPOSE

This chapter provides the basic requirements of the NASA Aviation Safety Program and also provides guidance for managers and Aviation Safety personnel to establish/implement their aviation mishap prevention programs. Mishap prevention in NASA is based upon the philosophy that mishaps can be prevented and that mishap prevention is an inherent function of leadership and management. NASA's major involvement in aeronautics dictates a commitment to aviation safety, under not only the Aviation Safety Program but also technology programs as well. In NASA, aviation safety shall be ensured to the extent possible through a comprehensive and proactive program covering all aspects of aviation.

701 AVIATION SAFETY PROGRAM

a. The NASA Aviation Safety Program requires aviation safety measures to be in effect at each level of aviation management. Under this concept, the Director/Aviation Manager responsible for aviation safety and risk management at each level is assisted by an Aviation Safety Officer (ASO)/manager who is an integral part of the Aviation Manager's staff and not part of a separate safety organization. The program is supported by system safety personnel as required. Headquarters safety personnel will conduct reviews and staff visits to provide oversight and monitoring of management's effectiveness in aviation safety, and technical and operational assistance to improve the overall safety program.

b. The highly diversified aviation activities within NASA require a tailored Aviation Safety Program for Headquarters and each flight activity. The primary responsibility for each Installation's Aviation Safety Program rests firmly with the Installation Director. For NASA Headquarters aviation operations, this responsibility lies with the Associate Administrator (AA) for Management Systems and Facilities (Code J). Aviation safety programs shall follow the applicable guidelines for each respective flight activity set forth in this chapter; NHB 7900.3 (V1), "Aircraft Operations Management Manual"; and NHB 7900.3 (V2), "Mission Management Aircraft Operations Manual."

702 PROGRAM RESPONSIBILITIES AND REQUIREMENTS

The NASA Aviation Safety Program is Agencywide, covering several Headquarters Offices and all Field Installations. To ensure effective implementation, an Aviation Safety Program shall conform to the organization's aviation management structure.

a. NASA Headquarters

(1) The NASA Administrator is the senior person responsible for Agencywide safety.

(2) The AA for Safety and Mission Assurance (AA for SMA) establishes NASA Aviation Safety Program requirements and provides support and independent oversight of NASA aviation safety. The AA for SMA shall provide the NASA Administrator an independent assessment of NASA's aviation safety status and provide immediate information on critical safety issues.

(a) Within the SMA Office, the Director, Safety and Risk Management Division (Code QS), through the designated NASA ASO, provides overall aviation safety oversight and NASA Headquarters management support for aviation safety. Through this independent oversight function, the Director shall ensure that Aviation Safety Program requirements are being applied at the appropriate levels of responsibility throughout NASA.

(b) The Director, Safety and Risk Management Division, shall provide aviation safety oversight and support through the following functions:

i Providing an ASO to be the independent Agency focal point for aviation safety issues.

ii Providing ASO and systems safety oversight to ensure Headquarters and Field Installation aircraft operations comply with NASA safety policy.

iii Coordinating all SMA (Code Q) requirements affecting aviation safety or reporting.

iv Ensuring there is an effective Agency mishap and incident reporting and corrective action system.

v Identifying aviation safety issues through mishap investigation and analysis.

vi Assigning an ASO ex-officio board member to major aircraft mishap investigations and providing independent oversight and expert guidance in investigation procedures and techniques.

vii Ensuring ASO participation in the annual NASA ASO meeting.

viii Monitoring and promoting Agencywide awareness of and motivation for the Aviation Safety Program.

ix Attending selected program Flight Readiness and Safety Reviews.

x Providing an ASO advisor to the Intercenter Aircraft Operations Panel (IAOP) to participate in IAOP activities, including meetings, reviews, and subpanel activities.

xi Developing the NASA Aviation Safety Reference Guide (QS-ASO-92-001) and ensuring that it is current and meets the needs of NASA.

xii Ensuring that the Aviation Safety chapter of this Handbook is current.

xiii Monitoring and acting on the aviation safety needs of the Headquarters Program Offices, Aircraft Management Office (AMO), IAOP and its subpanels, and Field Installations.

xiv Interfacing with other safety organizations.

xv Advocating aviation safety research.

xvi Conducting aviation safety staff visits and reviews.

xvii Coordinating recommendations from mishap investigations that require corrective action from sources or agencies outside of NASA.

xviii Participating in selected aircraft flight operations.

(3) The AA for Management Systems and Facilities, in accordance with NHB 7900.3 (V1), is responsible for policies and other matters related to NASA aircraft management. This includes developing guidelines for safe aircraft operations and implementing an

Agencywide Aviation Safety Program in accordance with Agency policies.

(4) NASA Headquarters Institutional Program Offices have line management responsibility for aviation safety for their respective Installations/flight operations. This requires ensuring implementation of aviation safety programs for their Installations, allocating aviation resources to meet objectives/programs safely, promulgating safety awareness, conducting mishap investigations, and developing/implementing corrective action.

(a) A senior, single point of contact for aviation safety and aviation management shall be designated within these offices to provide liaison with the Office of SMA and the Office of Management Systems and Facilities (Code J).

(b) The AA for Aeronautics (Code R) manages aviation safety-related technology and research programs.

b. The Aerospace Safety Advisory Panel (ASAP) was established as an advisory committee to NASA by Section 6 of the NASA Authorization Act, 1968 (PL 90-67, codified as 42 U.S.C. 2477). The panel reviews and evaluates program activities, systems, procedures, and management policies and provides assessment of these areas to NASA management and Congress. It is in this role that the panel provides independent advice on NASA aviation safety-related issues to the AA for SMA and to the Administrator.

c. Field Installations and Personnel

(1) Field Installation Directors. The Installation Director is the primary NASA official responsible for ensuring the safe operation of all aircraft assigned to the Installation, and for establishing and implementing an Aviation Safety Program tailored to their aircraft/airfield operations. The Directors accomplish these tasks by compliance with NASA Headquarters directives and their own directives. They are assisted by NASA Headquarters staff visits and the reports and recommendations of the IAOP and ASAP.

(2) Installation Aviation Manager of Flight Operations

(a) The Aviation Manager is the senior line person assigned aircraft operations responsibilities. The manager depends on the ASO to identify mishap potential and assist in administering the Mishap Prevention Program. However, the manager cannot delegate the line responsibility for the prevention of mishaps. A manager's experience, leadership,

and philosophy are decisive factors in ensuring safe operations.

(b) Aviation Managers of Flight Operations shall ensure that their policy and procedures covering flight/flight test/airfield/aircraft operations includes, as appropriate for their operation, the following requirements:

i Flight rules, regulations, and other advisory material required for safe flight operations are obtained/published and updated, and all personnel understand and comply with them. Where local conditions or special mission requirements dictate, special rules/procedures should be established and followed.

ii Restrictions to flight, Notice to Airmen (NOTAM), Weather (WX), or other pertinent information are readily available prior to initiation of flight operations. Aviation Managers should not waive any safety requirements set by regulations, NMI's, or other authoritative sources, unless the risk is accepted. In these cases, managers should justify and document their actions in writing, with approval of the Installation Director and appropriate Headquarters officials.

iii A crew rest policy is in effect.

iv Functional and effective Foreign Object Damage (FOD) prevention and tool control programs are in effect.

v Aerial demonstrations involving NASA aircraft, if conducted, encompass the Installation top management's approval to include flight routines, pilot assignment, training prerequisites, and weather limits.

(3) Installation Aviation Safety Officer. Although the ASO's perform primarily pilot duties at most Installations, the ASO position should be a full-time responsibility. Because the ASO serves as the manager's focal point for aviation safety matters, this individual should report directly to the senior aviation manager responsible for risk management. The ASO also acts in behalf of the Installation Director when discharging this responsibility. The ASO shall foster aviation safety measures and use all resources available to promote mishap prevention. ASO selection should be based on education,

experience, and ability. This individual ideally should be on flight status, current in assigned aircraft, a graduate of an approved aviation safety course, and have experience in aircraft mishap investigation. To accomplish these tasks, the ASO should refer to the NASA Aviation Safety Reference Guide to ensure appropriate elements are contained in the Installation's aircraft Mishap Prevention Program.

(4) Pilot-In-Command

(a) The NASA aircraft Pilot-In-Command (PIC) is responsible at all times for the safe operation of the aircraft and the safety of the passengers. The PIC is the final authority as to whether a flight shall be delayed or diverted for reasons of weather, aircraft conditions, or other safety-related considerations.

(b) The PIC shall ensure that passenger briefings are conducted and include pertinent egress, safety, and emergency information.

(5) Individual Responsibilities. All personnel, including contract personnel associated with NASA flight operations, shall conduct aviation-related activities in a safe and responsible manner and in compliance with NASA aviation guidelines and safety programs. Contracts involving or affecting aviation operations shall stipulate compliance with aviation safety requirements. Aviation safety is a personal responsibility of every person involved in aviation-related activities.

703 AVIATION SAFETY PROGRAM ELEMENTS

This paragraph discusses the general elements of an effective Aviation Safety Program. Each Field Installation shall implement an aircraft Mishap Prevention Program that includes the elements appropriate for their operation. Detailed elements are contained in the NASA Aviation Safety Reference Guide.

a. Aircraft Mishap Prevention Survey/Review. A NASA Headquarters aviation safety review of each Field Installation is required biennially. The IAOP, with the assistance of the AMO, conducts these formal reviews with independent safety oversight by the Headquarters Safety and Risk Management Division (Code QS). Installations should conduct internal surveys during the alternate year. These reviews provide an objective evaluation of aircraft operations, maintenance, crew procedures, and facilities to ensure safe and efficient operation and aircraft usage consistent with assigned goals and Field Installation requirements.

b. The Aviation Safety Reporting System

(1) A major program jointly sponsored with the Federal Aviation Administration (FAA) is the NASA Aviation Safety Reporting System (ASRS). This program is designed to identify and publicize deficiencies/discrepancies that have potential safety impact on the aviation community. The program does not address mishap reports but rather solicits reports of perceived safety hazards through a system of protected reporting. This system receives, stores, and distributes pertinent data. It also analyzes the data, conducts special studies, and reports on the results.

(2) The Office of Management and Budget (OMB) Report Control Number for the ASRS is 04-R-9206, which has been assigned to Ames Research Center Form 77.

(3) All ASO's should use the services of the ASRS program, support its objectives, and integrate the program's output into their local aviation safety program. They should encourage pilots and other members of the aviation community to submit timely reports of hazardous conditions or incidents as prescribed under the ASRS program.

c. Aircraft Mishap Reporting and Investigation. The principle of mishap reporting and investigation is central to an effective aviation safety program and shall be conducted in accordance with the current NMI 8621.1, "Mishap Reporting and Investigating"; NHB 1700.1(V2), "Guidelines for Mishap Investigation"; and Chapter 10 of this document.

d. Incentives and Awards. All aviation personnel desire both satisfaction and recognition for their achievements. Safe behavior should be recognized and rewarded. Properly used, incentives and awards can be extremely effective in both motivating and maintaining safe behavior. Further information on awards is located in Chapter 1 and Appendix D.

e. Occupational Health, Medical Clearance, Emergency Egress, and Survival. Close coordination with occupational health and medical officers and aviation personal equipment specialists shall be maintained. This enhances protection of aircrew and passengers by ensuring proper medical clearances for flight duties, adequate training, and properly maintained and functioning emergency survival equipment. The proper care and use of parachutes, egress systems, breathing equipment, protective equipment, and survival gear are subjects for safety surveillance. The aviation medical

program and aviation life support equipment are important components of this safety program element.

(1) The Aviation Medical Program. The objectives of the Aviation Medical Program are to promote aviation safety and prevent illness and injury of aviators and aviation support personnel. Specific aims are to promote the health and safety of aviation personnel through appropriate preventive medicine practices; ensure a safe, toxic-free environment for aviation personnel; and evaluate personal equipment and the man/machine interface for toxic and hazardous conditions. Managers shall ensure establishment and support of an aviation medicine program tailored to specific needs of aviation personnel supported.

(2) Aviation Life Support Equipment. Aviation Life Support Equipment (ALSE) is a vital link to a comprehensive aviation safety program. The responsibility, accountability, inspection, and maintenance of this equipment should be delegated to support personnel who are familiar with the equipment, experienced and knowledgeable in aviation concept, and aware of the need for ALSE. ALSE school attendance is desirable and encouraged.

f. Facilities. Adequate flight facilities shall be established and maintained. These include airfield, aircrew, maintenance, aircraft service life extension facilities, and Crash, Fire, Rescue (CFR) facilities. Emergency facilities shall be defined and provided for all off-site operations.

g. Cargo Safety. Provisions shall be made for the safe handling and stowing of cargo, including hazardous materials, in NASA aircraft. Additionally, contract carriers and airlift services used by NASA are required to abide by sound safety practices and Department of Transportation (DOT) regulations in the transportation of hazardous materials and cargo. Mixed cargo and passenger loads shall be monitored for safe practices.

h. Dissemination of Aviation Safety-Related Material. The best aviation safety material contributes very little to safety programs unless it is read or used by the people who are part of the Aviation Safety Program. Aviation Safety Managers should ensure that these materials are distributed throughout their Installations and other sites. Safety information that would be of interest Agencywide should be sent to Code QS for distribution. This information may assist in saving lives and preserving valuable resources.

i. Aviation Safety Reference Guide. Additional information on aviation safety is contained in the Aviation Safety Reference Guide.

704 INTERFACES WITH OTHER AGENCIES

NASA aviation activities interface with the aircraft industry, DOT/Federal Aviation Administration (FAA), the Department of Defense (DoD), and foreign governments. These resources shall be used fully in aviation safety matters.

a. Interagency Committee for Aviation Policy (ICAP). The ICAP was established by GSA Order ADM 5420.99, dated August 9, 1989, as directed by revised OMB Circular A-126, issued January 18, 1989. The committee's goal is to coordinate Governmentwide improvements in efficiency, effectiveness, economy, and safety of Federal executive agency public aircraft activities. NASA is represented on the executive committee by one primary and one alternate representative from Code J, and by representatives from both Codes J and Q, on the following subcommittees: Regulatory Policy; Safety, Standards, and Training; and Data Management Systems.

b. Department of Transportation. NASA Aviation Safety has a direct interest in FAA flight services and facilities used by NASA aircraft. These include departure, enroute, and arrival procedures, and the airways, restricted airspace, and local flying/training areas. Cooperation with FAA at the local level should foster a mutual understanding in developing safe aviation control procedures. Research and development (R&D) activities present opportunities for NASA/FAA cooperation to enhance safety.

c. Department of Defense. Because NASA uses many military airfields and aircraft common to the military services, coordination with the Army, Navy, and Air Force is required. Use of the various Service safety publications, cross-exchange of accident prevention data, and participation in joint safety efforts should provide mutual benefits. Safety and accident investigation provisions are included in joint agreements with DoD agencies for joint use or loan of aircraft.

d. Industry. Although this interface is normally through the contracting officer, special safety provisions in contracts should permit or require exchange of accident information concerning the types of aircraft involved. Safety personnel should participate in design reviews and inspections during the acquisition phase to ensure proper safety coverage.

e. Foreign Governments. Most foreign interface occurs during joint research or exchange programs and aviation shows/displays. Aviation safety is keyed to saving lives and property and should not have political or national boundaries.

This page intentionally left blank.

CHAPTER 8: FACILITY SAFETY

800 PURPOSE

This chapter establishes safety policies and requirements to enhance NASA's facility acquisition, construction, and activation process. The chapter expands on the general approach for NASA Field Installations to implement tailored safety programs that will adequately support concept planning, design, and construction phase activities for NASA facility project work. The Facility Safety Management Plan (SMP) for each project shall include those tasks described in paragraph 807 that are appropriate considering the size and complexity of the project and associated safety risks.

801 POLICY

* To achieve facility acquisition, construction, and activation of safety assurance objectives, it is NASA safety policy to:

a. Designate and assign facility safety program responsibilities to a NASA Field Installation safety, reliability, maintainability, and quality assurance (SRM&QA) organization that is independent from the specific facility (user) management.

b. Regardless of the source or amount of funds, ensure the fire protection and safety organization reviews all proposed NASA owned, controlled, or operated facility configuration changes and construction work change orders that have a potential safety impact. This does not preclude the use of checklists and other guidelines to assist the project in determining the potential safety or fire impact.

c. Incorporate selective and verifiable safety criteria or requirements into the facility project design, construction work bid packages, and the facility operation and maintenance instructions in accordance with NHB 7320.1, "Facilities Engineering Handbook," and NHB 8820.2, "Facility Project Implementation Handbook."

d. Ensure preconstruction planning and design requirements are specific and comply with applicable Federal, national consensus, State, and local building codes and standards, and with facility equipment standards or procedures approved by OSHA or NASA as supplementary and alternate standards.

* Occupational Health personnel are responsible for facility related health concerns.

e. Mandate compliance with NASA supplementary and alternate safety standards that may apply for all NASA-managed construction work. For construction undertaken at NASA by the U.S. Army Corps of Engineers, compliance with EM 385-1-1, "U.S. Army Corps of Engineers, Safety and Health Requirements," is mandatory. For related NASA-managed projects, EM 385-1-1 will be considered as an advisory document. Any unique NASA facility or equipment standards and operating procedures not addressed by OSHA standards shall be developed and maintained by the NASA Field Installation, and approved by the NASA Headquarters Director of Safety or Director of Occupational Health in accordance with NHB 2710.1, "Safety and Health Handbook - Occupational Safety and Health Programs."

f. Ensure that any final inspection effort (Operational Readiness Inspection (ORI), Operational Readiness Review (ORR), Test Readiness Review (TRR), Pre-Final Inspection (PFI), Final Inspection (FI), etc.) includes a Safety and/or Health representative as appropriate and that all facility safety and health issues are documented, resolved, or adequately controlled prior to acceptance and/or activation.

g. Ensure facility operation and maintenance instructions and changes are developed by the Field Installation based on the facility mission and operational requirements. All procedures shall include sufficient detail to identify residual hazards and cautions to NASA personnel. Deviation or changes to Hazardous Operating Procedures (HOP's) require the approval of the cognizant NASA/contractor safety or health offices. Those procedures and instructions identified as hazardous shall require fire protection and safety office approval as provided in Chapter 6 and Appendix I.

h. Ensure technical and management requirements are met by contractors.

802 OBJECTIVES

NASA's facility acquisition safety and construction safety objectives are to:

a. Identify, track, and resolve hazards at the earliest possible phase to minimize the cost and need for a retrofit program.

b. Perform safety oversight functions to ensure compliance with NASA safety policies.

c. Provide for review of all proposed projects to ensure that all safety requirements are specified and funds are adequately allocated.

d. Provide the necessary technical reviews that include safety aspects of all facility acquisition and construction efforts to ensure that they are being conducted in accordance with sound safety engineering principles.

e. Monitor compliance of appropriate safety and fire protection codes and standards for facility construction, modification, repair, and rehabilitation. NASA fire protection and safety personnel shall monitor the compliance effort in the various phases of the projects. For projects with safety or fire protection implications, this effort will be formal, with the safety office/fire protection office providing a formal sign-off.

803 APPLICABILITY AND SCOPE

This chapter is not a direct instruction to NASA contractors who provide planning, Architect-Engineering (A-E) design, or construction contract services. It is guidance to the responsible NASA Field Installation program/project management, contracting office, safety assurance, and fire protection organization personnel who implement the safety programs essential to meeting each facility acquisition and construction work package effort in accordance with NHB 7320.1 and NHB 8820.2. This chapter shall be applied to Construction of Facilities (CoF) projects including discrete program (restoration/modernization, new capability), minor program (repair, rehabilitation/modernization, minor construction) facilities maintenance projects, and environmental compliance and restoration projects. This chapter shall also be applied to Field Installation approved projects according to the degree of impact of safety policy and regulatory considerations on those projects. This document shall not supersede more stringent requirements imposed by individual NASA organizations and other Government agencies.

804 AUTHORITY AND RESPONSIBILITY

If non-compliance with local, State, or Federal laws and requirements is identified during the planning phase of a project, the Field Installation Director will provide documentation and rationale to the governing authority requesting comments. A NASA requirement shall be waived only in accordance with Chapter 1, paragraph 121, of this document.

805 FACILITY SAFETY PROGRAM

The facility safety program will promote and provide safety oversight throughout all phases of the facility life cycle. Specific safety tasks shall be accomplished to ensure safety during construction, operation, maintenance, and final disposition of the facility. Safety tasks included in each phase are discussed in the SMP, which will be included in the Facility Project Management Plan in accordance with NHB 8820.2. The SMP for each facility acquisition should be tailored to include those tasks appropriate considering the size and complexity of the project and associated safety risks. Appendix J provides a review of the facility life cycle and

the safety tasks that shall be accomplished (as applicable) during a facility acquisition project life cycle.

806 FACILITY MANAGERS

The Field Installation Director or designee can appoint a facility operations manager or facility coordinator to oversee proper operation of the facility. A safety coordinator may be appointed to assist the manager. The extent of each authority shall be detailed in writing to ensure complete safety coverage of all facility operations. The Installation safety office will interface with the facility managers or safety coordinators as appropriate to ensure proper safety program implementation.

807 FACILITY SAFETY MANAGEMENT PLAN

a. Safety Management Plan. Field Installations shall document and maintain a written facility SMP for each major facility acquisition to monitor timely completion of all required life cycle safety program tasks. The SMP may be contractually proposed or prepared in-house. This plan shall be used to implement tailored safety requirements, including organizational responsibilities, resources, milestones, methods of accomplishment, depth of effort, and integration with other program engineering and management activities and related systems. For minor or normal acquisitions and facility modification projects, the SMP can be tailored but will include the appropriate local directives, instructions, and guidelines as a minimum.

b. Safety Program Plan. For scenarios using contractors to provide facilities, the contractors will be required to provide a Safety Program Plan (SPP) to address facility safety as a minimum, consistent with the ability to tailor to the requirements in this chapter. See Appendix E for an outline of information included (as applicable) in an SPP.

c. Milestones Schedule. The SMP shall contain a realistic milestone schedule commencing with the functional requirements and facilities concept development phase to monitor timely completion of all required safety program tasks for the facility project design. The milestone schedule shall also include safety management during construction, and the operation and maintenance considerations (instructions, training, provisioning of parts, special tools, and supplies) cited in Chapter 2 of NHB 7320.1 and NHB 8831.2, "Facilities Maintenance Handbook," for complex facility projects or the use of specialized equipment. All SPP milestones shall support the scheduled facility need date or occupancy date, as appropriate.

CHAPTER 9: FIRE SAFETY

900 PURPOSE

This chapter establishes policy and overall requirements for a NASA Fire Safety Program.

901 POLICY

It is NASA policy to:

a. Maintain a comprehensive Fire Safety Program. Specific program requirements and procedures are provided in NHB 1700.1(V9), "NASA Safety Manual — Fire Protection." (NOTE: This document will be replaced by NSS 1740.XX, "Safety Standard for Fire Protection," when approved.)

b. Provide appropriate automatic fire detection and suppression systems for all facilities containing significant hazards, mission essential equipment, or permanently housed personnel. (See NHB 1700.1(V9) for specific requirements.)

c. Comply with nationally recognized building and fire safety codes and any applicable local codes in accordance with Public Law 100-678, "Public Buildings Amendments of 1988" (November 17, 1988; Section 6).

d. Ensure employees, other than trained professional firefighters, trained volunteers, or emergency response personnel, do not fight fires except in cases where the fire is incipient in nature.

e. Adhere to the more stringent of fire safety requirements imposed by local, State, or Federal agencies.

902 OBJECTIVES AND GOALS

The objective of NASA fire safety policy is to protect human life, property, and the environment from the risk of fire-related hazards. The goals are zero loss of life from fires, a reduction in number of fires to zero, protection for facilities and equipment to preclude major losses, and a reduction in the magnitude of loss for those fires that occur.

903 RESPONSIBILITIES

a. Each NASA organization is responsible for identifying and reducing fire safety hazards, ensuring fire safety of its operations, and implementing the directives of this chapter. Field Installations are responsible for following applicable government laws and requirements for fire protection in

construction and building codes as well as ensuring implementation of NASA operational fire safety directives.

b. The Authority Having Jurisdiction (AHJ) for NASA fire protection will be designated in writing by the Field Installation Director and shall be a safety or fire protection professional.

c. Each Field Installation's fire and safety organization shall review and approve all project plans and design documents with safety and/or fire protection implications.

904 FIRE PROTECTION SURVEYS AND INSPECTIONS

Fire hazards will be identified through comprehensive fire risk evaluation, discrepancies documented, and abatement plans prepared for corrective action. Those items that cannot be corrected or funded locally must be forwarded to Headquarters for resolution. Engineering surveys and fire inspections will be conducted and documented.

905 FIRE PROTECTION SYSTEMS

a. Fire Protection Doctrine. The nature of NASA's mission is such that a significant number of specialized facilities and operations exist along with the more conventional structures and work routines. As a result, difficulties arise in the determination of the required level of fire safety. Conventional fire protection doctrine and existing codes and standards may not be appropriate, but safeguards can be assured by following the policies outlined in this document and in NHB 1700.1(V9).

b. Extinguishing Systems. Extinguishing systems and fire extinguishers shall comply as a minimum with the National Fire Protection Association (NFPA) codes and standards. All fire protection equipment shall be Underwriter Laboratories (UL) listed or Factory Mutual (FM) approved.

906 FIREFIGHTING

Firefighting organizations may be established or provided to ensure adequate protection to life and property. NFPA recommendations shall be used for determining type, size, and training of firefighting organizations. When agencies external to NASA provide fire protection, the agreed-upon arrangement must be documented and retained on file.

907 EMERGENCY (PRE-FIRE) PLANNING AND PROCEDURES

Specialized facilities and critical areas that constitute a major portion of NASA operations demand a unique, preplanned response from the entire Agency. See NMI 1040.3, "Emergency Preparedness Program"; NHB 1700.1(V9); and the respective emergency preparedness plans for further information on specific critical areas and emergency plan procedures.

908 FIRE SAFETY TRAINING

Training for NASA employees shall be in accordance with the requirements and guidelines contained in Chapter 4 of this document; 29 CFR 1910.38, "Employee Emergency Plans and Fire Prevention Plans"; and NHB 1700.1(V9).

909 REPORTING

Reporting shall be an integral part of operational safety. Effective reporting procedures disseminate the knowledge and experience gained by one Field Installation to the rest of NASA and the Federal Government. Reporting shall be in accordance with NMI 8621.1, "Mishap Reporting and Investigating," and Chapter 10 of this document.

910 REGULATIONS, CODES, AND STANDARDS

With the goal of protecting life and property, NASA organizations must comply with the requirements of the following documents in the design, construction, and operation of all NASA buildings and structures. (Conflicts shall be documented and sent to NASA Headquarters for resolution.)

a. Federal Documents

(1) Public Law (PL) 100-678 (November 17, 1988; Section 6), "Compliance with Nationally Recognized Codes."

(2) 29 Code of Federal Regulations (CFR) Part 1910 Subpart L, "Fire Protection."

b. NASA Documents

(1) NHB 1700.1(V9). This standard contains specific NASA requirements and guidelines for the implementation of a comprehensive fire protection program.

(2) NHB 1700.1 (V1-B), "Safety Policy and Requirements Document."

(a) Paragraph 607, "Electrical Safety." Establishes codes that contain minimum fire safety requirements.

(b) Paragraph 615, "Launch Vehicle and Spacecraft Operations Safety." Provides policy, summary guidance, and requirements for protecting crew in a spacecraft workplace environment.

(3) NHB 8060.1, "Flammability, Odor, Offgassing and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion." This Handbook contains methods to assess flammability of materials.

(4) NHB 7320.1, "Facilities Engineering Handbook." This Handbook contains detailed NASA facility design and engineering requirements.

c. Other Standards. The use of NFPA standards, including their appendices, are mandatory unless the requirements of the local codes are more stringent (see paragraph 901). Mandatory standards that need to be addressed are:

(1) A nationally recognized building code or the appropriate local building code.

(2) NFPA fire codes and their appendices.

(3) NFPA Life Safety Code Handbook.

(4) NFPA National Electric Code Handbook.

CHAPTER 10: MISHAP REPORTING, RECORDKEEPING, AND INVESTIGATING

1000 PURPOSE

This chapter complements NMI 8621.1, "Mishap Reporting and Investigating," by providing additional details governing reporting and investigating mishaps to determine their causes, implement corrective actions, and document and disseminate lessons learned for the purpose of mishap prevention.

1001 APPLICABILITY AND SCOPE

a. Policies and Procedures. The policies and procedures stated in this chapter apply to reporting, investigating, and documenting the causes, corrective actions, and lessons learned from mishaps. These policies and procedures are applicable to NASA Headquarters and Field Installations. They serve as guidance to NASA contractors including those at foreign sites. Applicable portions of this chapter as well as the requirements delineated in NMI 8621.1 shall be incorporated into contracts covering NASA programs and operations to ensure NASA contractor mishap reporting and investigating are consistent with NASA requirements.

b. Agreements. Agreements between NASA and the Department of Defense, foreign governments, and contractors sponsoring independent commercial launches shall include the appropriate portions of this chapter to cover mishap reporting and investigating.

1002 MANAGEMENT RESPONSIBILITIES

a. The Associate Administrator (AA) for Safety and Mission Assurance (SMA) is responsible for directing the prompt, thorough, and accurate reporting, investigation, and analysis of all NASA mishaps, mission failures, and close calls. The AA for SMA or a designee shall participate in an ex-officio capacity in the proceedings of all investigation boards and may participate in investigations established by other NASA officials. The AA for SMA or designee shall serve as chair or ex-officio member of all mission failure review boards established by the Administrator. The AA for SMA shall concur on the membership of all Type A, Type B, and mission failure investigation boards. The AA for SMA shall ensure the implementation of all recommendations made by the board. To carry out these responsibilities, the AA for SMA, through the staff organization, shall:

(1) Manage the mishap notification system and serve as the initial official notification point at Headquarters.

(2) Review and concur with the membership for Headquarters and Field Installation appointed boards after assuring that the Administrator has had an opportunity to appoint the board. Except for joint NASA/Department of Defense (DoD) Space Shuttle mishaps, the AA for SMA shall serve as the focal point for the appointment of NASA personnel to joint NASA/DoD and other boards in accordance with applicable agreements.

(3) Review and concur with the results of the investigation including analysis of evidence, determination of causal factors, findings and recommendations, the corrective action plan, and lessons learned to ensure that NASA policy and requirements are met prior to final acceptance of the investigation report.

(4) Establish a repository for documented witness testimony and for investigation reports of Type A and B mishaps, including mishaps investigated at those levels, and mission failures.

(5) Manage the Mishap Reporting and Corrective Action System and the Lessons Learned Information System (LLIS).

b. Program AA's are responsible for including in contingency plans steps to implement the requirements of this chapter and those delineated in NMI 8621.1 within their respective jurisdictions. These requirements include:

(1) Immediately notifying the responsible safety and/or health official as appropriate as well as the Office of Public Affairs and the NASA Safety and Risk Management Division or Occupational Health Division of immediately reportable mishaps.

(2) Appointing, with the concurrence of the AA for SMA, the chairperson and members of the investigation board for Type A mishaps and mission failures.

(3) Monitoring and reviewing progress of the investigation.

(4) Accepting the board's report, or rejecting the report and redirecting the board.

(5) Developing a formal Corrective Action Implementation Plan and final lessons learned.

(6) Publishing and distributing the investigation report after concurrence by the AA for SMA.

(7) Monitoring progress of the Corrective Action Implementation Plan and submitting quarterly status reports to the Director of the NASA Safety and Risk Management Division until the plan is fully implemented.

(8) Ensuring that the following statement is included in contingency plans: "When local Installation and Program Directors/Managers are notified of reportable mishaps by any office or source other than safety personnel, the Installation and Program Directors/Managers shall immediately notify their local safety personnel who shall notify the NASA Safety and Risk Management Division (for immediately reportable mishaps), or shall make provision for direct notification of the NASA Safety and Risk Management Division themselves, with later notification of others."

c. Field Installation Directors are responsible for including in contingency plans the steps to implement the requirements of this chapter and those in NMI 8621.1 within their respective jurisdictions. These requirements include:

(1) Immediately notifying the official local safety point of contact and health official as appropriate as well as the designated Public Affairs Office and the NASA Safety and Risk Management Division for immediately reportable mishaps.

(2) Ensuring that appropriate actions are taken immediately following a mishap to control the emergency, preserve evidence, and limit further damage or injury.

(3) Appointing, with the concurrence of the AA for SMA, the chairperson and members of the investigation board for Type B mishaps.

(4) Monitoring and reviewing the progress of the investigation.

(5) Accepting the board's report or rejecting it and redirecting the board.

(6) Developing a formal Corrective Action Implementation Plan.

(7) Publishing and distributing the investigation report after concurrence by the AA for SMA.

(8) Monitoring progress of the Corrective Action Implementation Plan and submitting quarterly status reports to the Director, Safety and Risk Management Division, until the plan is fully implemented.

(9) Operating and maintaining the local Mishap Reporting/Corrective Action System (MR/CAS).

(10) Ensuring that lessons learned are developed from mishap experience and from close calls and entered into the LLIS.

(11) Ensuring that the following statement is included in contingency plans: "When local Installation and Program Directors/Managers are notified of reportable mishaps by any office or source other than safety personnel, the Installation and Program Directors/Managers will immediately notify their local safety personnel who will notify the NASA Safety and Risk Management Division (for immediately reportable mishaps), or will make provision for direct notification of the NASA Safety and Risk Management Division themselves, with later notification of others."

1003 REQUIREMENTS

a. All mishaps will be reported and investigated in compliance with this chapter and NMI 8621.1. Reportable mishaps include fatalities, injuries/illnesses requiring more than first aid treatment; damage to or loss of NASA equipment/property equal to or greater than $1,000; and mission failures where less than majority of stated objectives are met (dollar value is not a criterion); and close calls with high severity potential.

b. An Investigation Board will be appointed for all Type A and B mishaps and mission failures as well as other mishaps that have sufficient programmatic, public, or political impact. Less serious mishaps that have the potential for serious injury/illness, death or equipment/property damage greater than or equal to $250,000 will be investigated at the Type A or B level. The level will be determined by the appropriate Headquarters officials and the Installation Director. During the investigation and preparation of the report, the Investigation Board will remain autonomous and members will be relieved of all other duties.

c. Type C mishaps, less severe mishaps, and close calls will be investigated by a local investigation team or a single investigator. Causes, effects, corrective measures, and lessons learned shall be documented in mishap reports for both mishaps and close calls.

d. The organization responsible for the mishap will implement corrective actions and will report status to the local safety office and to the appointing official for Type A and B mishaps.

1004 DEFINITIONS

The following terms are used throughout this chapter. Additional definitions may be found in Appendix O.

a. NASA Mishap. Any unplanned occurrence, event, or anomaly that meets one of the criteria below. Injury to a member of the public while on NASA facilities is also defined as a NASA mishap.

(1) Type A Mishap. A mishap causing death and/or damage to equipment or property equal to or greater than $1,000,000. Mishaps resulting in damage to aircraft or space hardware, i.e., flight and ground support hardware, meeting this criterion are included. A Type A mishap also includes a test failure if the damage was unexpected or unanticipated or if the damage is likely to have significant program impact or visibility.

(2) Type B Mishap. A mishap resulting in permanent disability to one or more persons, hospitalization (for other than observation) of five or more persons, and/or damage to equipment or property equal to or greater than $250,000 but less than $1,000,000. Mishaps resulting in damage to aircraft or space hardware that meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

(3) Type C Mishap. A mishap resulting in damage to equipment or property equal to or greater than $25,000 but less than $250,000, and/or causing occupational injury or illness that results in a lost workday case. Mishaps resulting in damage to aircraft or space hardware that meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

(4) Mission Failure. Any mishap (event) of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives. A mishap of whatever intrinsic severity that, in the judgment of the Program Associate Administrator, in coordination with the Associate Administrator for Safety and Mission Assurance, prevents the achievement of primary mission objectives as described in the Mission Operations Report or equivalent document.

(5) Incident. A mishap consisting of less than Type C mishap severity of injury to personnel (more than first-aid severity) and/or property damage equal to or greater than $1,000 but less than $25,000.

(6) Close Call. An occurrence in which there is no injury, no significant equipment/property damage (less than $1000), and no significant

interruption of productive work, but which possesses a high severity potential for any of the mishaps as defined as Type A, B, C Mishap, Mission Failure, and Incident.

b. NASA Reportable Mishap. Any work-related mishap resulting in a death, permanent disability, or hospitalization of five or more persons; an occupational injury or illness which results in a lost workday case or medical treatment beyond first aid, loss of consciousness, restriction of work or motion, transfer to another job; or damage to, or loss of, equipment or property damage equal to or greater than $1,000. Mission failures and close calls with potential as Type A or B mishap are also reportable.

c. Immediately Reportable Mishaps. All Type A and B mishaps and mission failures that require immediate telephonic notification to local and Headquarters safety officials.

d. Medical Treatment. The following procedures are generally considered medical treatment. Any NASA work-related injury/illness for which this type of treatment was provided or should have been provided is considered a NASA Reportable Mishap:

- Treatment of infection.
- Application of antiseptics during second or subsequent visit to medical personnel.
- Treatment of second or third degree burn(s).
- Application of sutures (stitches).
- Application of butterfly adhesive dressing(s) or steri strip(s) in lieu of sutures.
- Removal of foreign bodies embedded in the eye.
- Removal of foreign bodies from wound if procedure is complicated because of depth of embedment, size, or location.
- Use of prescription medications (except a single dose administered on first visit for minor injury or discomfort).
- Use of hot or cold soaking therapy during second or subsequent visit to medical personnel.
- Application of hot or cold compress(es) during second or subsequent visit to medical personnel.

- Cutting away dead skin (surgical debridement).
- Application of heat therapy during second or subsequent visit to medical personnel.
- Use of whirlpool bath therapy during second or subsequent visit to medical personnel.
- Positive x-ray diagnosis (fractures, broken bones, etc.).
- Admission to a hospital or equivalent medical facility for treatment (not merely observation).

e. First aid. The following procedures are generally considered first-aid treatment (e.g., one-time treatment and subsequent observation of minor injuries). These injuries/illnesses are not considered NASA Reportable Mishaps if the work-related injury/illness does not involve loss of consciousness, a lost workday, restriction of work or motion, or transfer to another job:

- Application of antiseptics during first visit to medical personnel.
- Treatment of first degree burn(s).
- Application of bandage(s) during any visit to medical personnel.
- Use of elastic bandage(s) during first visit to medical personnel.
- Removal of foreign bodies not embedded in eye if only irrigation is required.
- Removal of foreign bodies from wound if procedure is not complicated and is, for example, by tweezers or other simple technique.
- Use of nonprescription medications and administration of single dose of prescription medication on first visit for minor injury or discomfort.
- Soaking therapy on initial visit to medical personnel or removal of bandages by soaking.
- Application of hot or cold compress(es) during first visit to medical personnel.
- Application of ointments to abrasions to prevent drying or cracking.

- Use of whirlpool bath therapy during first visit to medical personnel.
- Negative x-ray diagnosis.
- Observation of injury/illness during visit to medical personnel.

1005 REPORTING AND RECORDKEEPING PROCEDURES

a. All mishaps will be reported to the appropriate NASA Field Installation Safety Office. Each NASA and contractor employee on NASA property, or custodian of NASA assets elsewhere, is responsible for reporting mishaps. Notification of a mishap will be made immediately to a supervisor or safety or health staff member. The supervisor or safety or health staff member shall immediately notify the appropriate Field Installation Safety Office by telephone and provide the information required per NASA Form (NF) 1627A,"NASA Telephonic Mishap Report." (See Appendix B for NF 1627A.) Contractors are required to contact the Contracting Officer in addition to the appropriate NASA Field Installation Safety Office.

b. The Field Installation Safety Office shall immediately notify the NASA Safety and Risk Management Division during duty hours or the NASA Goddard Space Flight Center (GSFC) Emergency Console during non-duty hours of all immediately reportable mishaps as defined in paragraph 1004c. Information about these mishaps will be recorded on NF 1627A. Close calls and incidents, although falling within the excepted category, also will be reported immediately if the local safety official determines their potential for severity to be equivalent to those mishaps requiring immediate reporting. Other mishaps shall be reported electronically through the MR/CAS.

c. The NASA Safety and Risk Management Division will initiate the NASA Headquarters Mishap Notification Procedures (see Safety and Risk Management Division Document QS-DOI-91-003). The appropriate Institutional Program AA and the AA for SMA will be notified.

d. All reportable mishaps will be recorded on NF 1627, "NASA Mishap Report," in accordance with the instructions in Appendix K. Contractors will submit to the appropriate NASA Field Installation Safety Office and the Contracting Officer mishap reports as required in the contract Statement of Work or contract specifications. In consultation with the Field Installation Safety Office, the Contracting Officer will establish frequency and due dates for this report. Contractors may use their own format for this report, but as a minimum will include the number of employees working on the contract, the number of actual hours worked (in accordance with Appendix N, paragraph d(3)), totals of lost time and no-lost time cases, frequency rates (Rate = cases x 200,000/hours worked),

and totals of all other mishaps by type, including close calls. This information is required to calculate the frequency rates used in evaluating contractor performance. For additional information on reporting work-related injuries and illnesses, refer to OMB No. 1220-0029, "Reporting Guidelines for Occupational Injuries and Illnesses," published by the U.S. Department of Labor, Bureau of Labor Statistics, September 1986. Additional information is contained in NMI 3810.1, "Processing Claims Under the Federal Employees' Compensation Act." Processing claims and submitting reports to the Department of Labor are under the policies of the Director, Occupational Health Office, at NASA Headquarters.

e. NASA safety personnel at the Branch Chief level or higher (or equivalent position) will approve all corrective action plans and indicate agreement with each plan by signing the concurrence block on NF 1627. The appropriate safety or health personnel are responsible for ensuring that all corrective actions have been implemented and for approving the closure of a mishap report by signing in the Approval for Closure block on NF 1627.

f. Notification of OSHA. The NASA Safety and Risk Management Division will notify the OSHA Office of Federal Agency Programs within 48 hours when a NASA mishap involves a fatality or the hospitalization (for other than observation) of five or more NASA employees or NASA/non-NASA employees combined. Contractors must also report these mishaps to OSHA. Special OSHA reporting procedures apply for mechanical power press injuries. Each Field Installation will report the circumstances of these injuries to OSHA within 30 days of the occurrence. The criteria, format, and information requested are contained in 29 CFR 1910.217(g). Copies of all reports submitted will be provided to the AA for SMA who will coordinate with the Director, Occupational Health Office, as appropriate.

g. Exclusions. NASA allows most of the same exclusions as OSHA from reporting work-related injuries and illnesses. However, a restricted duty case where an employee does not lose any workdays but is assigned "light" duty is not considered a NASA lost time case. Also, part of a workday lost for medical treatment or therapy does not count as lost time. For additional information on exclusions to reporting work-related injuries and illnesses, refer to OMB No. 1220-0029, September 1986 and NMI 3810.1. The following is a list of NASA exclusions from reporting both injuries and hardware-related mishaps or occurrences in the MR/CAS:

(1) Injuries associated with nonoccupational diseases where the disease itself, not the injury, is the proximate cause of the lost time. Example: A hemophiliac suffers a minor laceration that results in time away from work.

(2) Injuries occurring in parking lots of NASA facilities.

(3) Injuries/Illnesses sustained before entry into NASA service or employment unless specifically aggravated by current tenure of service.

(4) Injuries resulting from non-work related, preexisting musculoskeletal disorders or by minimum stress and strain (example: simple, natural, nonviolent body positions or actions). These injuries/illnesses are unrelated to accident-producing agents or environments in daily work.

(5) Injuries experienced during unsupervised or unsponsored recreational activities (e.g., during volleyball game at lunch period).

(6) Injuries occurring during official travel that result from personal, non-NASA sponsored recreational activities (e.g., skiing or tennis accidents).

(7) Anticipated illness or injury resulting from tests on human subjects.

(8) Malfunction or failure of component parts that are normally subject to fair wear and tear and have a fixed useful life less than the complete system or unit of equipment is not considered a mishap, provided that:

(a) The malfunction or failure is the only damage.

(b) The sole action is to replace or repair that component part.

This exception does not apply to a malfunction or failure of a component part that results in damage to another component.

(9) Anticipated damage to equipment or property incurred during authorized testing.

(10) Property damage as a result of vandalism, riots, civil disorders, or felonious acts such as arson or sabotage.

1006 BOARD APPOINTMENT PROCEDURES AND MEMBERSHIP REQUIREMENTS

Upon notification of a Type A or B mishap, mission failure, or any other mishap or close call that will be investigated at the Type A or B level, the appropriate appointing official will initiate communications with the appropriate personnel to discuss board member appointments and the course of action to follow. (See

Figure 1000-1, Schedule for Mishap Reporting, Investigating, Followup, Closeout for Type A and B Boards, and Appendix L for the list of participants.)

a. Board Appointment Responsibilities. Responsibility for investigating those mishaps that require boards of investigation (Type A and B mishaps, mission failures, and those other mishaps and close calls that have a high degree of programmatic, public, or political impact) is as follows:

(1) Program Associate Administrators

(a) The appropriate Institutional Program AA, known as the appointing official, will appoint a chairperson and members of the mishap investigation board for Type A mishaps, mission failures, and close calls with Type A severity potential, unless the NASA Administrator chooses to appoint the board. (This is often referred to as a Headquarters-appointed board.) The appointing official will contact the Administrator as soon as possible (generally within 1 hour of initial notification) to determine if the Administrator desires to appoint the board. The appointing official must obtain the concurrence of the AA for SMA in the appointment of investigation boards.

(b) The appointing official, with the concurrence of the AA for SMA, may delegate appointing authority to a Field Installation Director or elevate the level of investigation of a less serious mishap if the potential for a major mishap existed. When this occurs, the board appointment letter will state the level (A or B) at which the investigation will be handled.

(2) Field Installation Directors. They will appoint a chairperson and members of investigation boards for Type B mishaps (Installation-appointed board), which involve the functions, resources, and activities of a particular Installation or where, by agreement with the appropriate Institutional Program AA and the AA for SMA, the Field Installation Directors have been designated to take the lead in investigations. The Field Installation Director must obtain the concurrence of the AA for SMA in the appointment of all Type B mishap boards or Installation-appointed mission failure boards. For Type C mishaps, incidents, or close calls with high severity potentials, all of which involve the functions within a particular Installation, the Field Installation Director will appoint, with the concurrence of the Field Installation Safety Official, an investigator or investigation team consisting of two or more members, depending on the significance of the mishap. A local board may be appointed in unusual cases; however, in most cases this requirement will be

satisfied by the investigation performed by the local NASA safety official.

(3) Program Directors/Managers. They (or Program/Project Managers for programs with no Program Director) will appoint a chairperson and members of investigation boards for Type B mishaps, which involve only the functions, resources, and activities of particular programs, or where by agreement with the appropriate Program AA's and the AA for SMA, the Program Director/Manager has been designated to take the lead in investigations. The Program Director/Manager must obtain the concurrence of the AA for SMA in the appointment of all Type B mishap boards and mission failure boards.

(4) Associate Administrator for SMA. With the exception of joint NASA/DoD Space Shuttle mishap investigation boards, the AA for SMA will be the appointing authority for NASA joint participation on boards with the DoD and other agencies or Foreign Governments. In this role, the AA for SMA will consult with the appropriate Program Director/Manager in the selection of personnel appointed to chair or serve as board members. The AA for SMA will also contact the NASA Administrator (generally within 1 hour of the initial notification of the mishap) to determine if the Administrator wishes to exercise appointment authority.

(5) Balloon and Sounding Rocket Program Officials. Mission failures occurring in the Balloon and Sounding Rocket programs, which are low-cost and often use reusable hardware, will be investigated by the normal project-level technical investigation teams. If the mission failure results in death, injury/illness, or unanticipated damage to nongovernment property, reporting and investigating procedures detailed in this chapter will be followed. Program officials will prepare an annual fiscal year report. An annual review of the fiscal year's mission failures and lessons learned will be conducted by officials from GSFC and the NASA Safety and Risk Management Division. All mishaps and close calls will be reported by program officials to the appropriate safety officials at the GSFC and will be recorded on NF 1627 per the requirements in this chapter (see letter of agreement between GSFC/Wallops Flight Facility (WFF) and the NASA Safety and Risk Management Division, March 27, 1991).

NOTE: See Appendix M, "NASA Guidelines for Establishing a Mishap Investigation Board," for assistance in preparing the board appointments.

TIME	ACTION	RESPONSIBLE PARTY
M	MISHAP OCCURS	
M+ASAP	NOTIFY SAFETY AND RISK MANAGEMENT DIVISION (QS)	APPROPRIATE INSTALLATION SAFETY OFFICIAL
	NOTIFY HQ OFFICES	CODE QS
	INITIATE CONFERENCE FOR BOARD APPOINTMENT	APPOINTING OFFICIAL
M+1 DAY	FILE INITIAL MISHAP REPORT (NF 1627) WITH APPROPRIATE SAFETY OFFICE	REPORTING ORGANIZATION (CONTRACTOR OR NASA)
M+1 to 2 DAYS	ENTER DATA INTO MR/CAS	APPROPRIATE SAFETY OFFICIAL
	SEND BOARD APPOINTMENT LETTERS	APPOINTING OFFICIAL
M+3 DAYS	BOARD CONVENES	BOARD CHAIRPERSON
M+3 to 5 DAYS	SEND INTERIM (2-WK) STATUS REPORTS TO APPOINTING OFFICIAL AND DIRECTOR, CODE QS	BOARD CHAIRPERSON
M+60 DAYS	SEND UPDATED BOARD REPORT (ALL VOLUMES) TO APPOINTING OFFICIAL	BOARD CHAIRPERSON
M+30 DAYS	ACCEPT/REJECT REPORT	APPOINTING OFFICIAL
	DEVELOP FORMAL CORRECTIVE ACTION IMPLEMENTATION PLAN	APPOINTING OFFICIAL
	FORWARD 15 COPIES OF REPORT AND CA PLAN TO DIRECTOR, CODE QS (VOL. V IS NOT TO BE REPRODUCED. SEND ORIGINAL UNDER SEPARATE COVER TO DIR., CODE QS.)	APPOINTING OFFICIAL
M+95 DAYS	DISTRIBUTE REPORT AND PLAN TO HQ OFFICES	DIRECTOR, CODE QS
	DISPOSITION ALL COMMENTS	DIRECTOR, CODE QS
M+105 DAYS	CONCUR AND DATE REPORT	AA FOR SMA
M+145 DAYS	DISMISS BOARD, PUBLISH AND DISTRIBUTE REPORT	APPOINTING OFFICIAL
M+160 DAYS	FILE FOLLOW-UP 1627 WITH LOCAL SAFETY OFFICE	REPORTING ORGANIZATION
	ENTER APPROPRIATE FINAL MISHAP INFORMATION INTO MR/CAS	APPROPRIATE SAFETY OFFICIAL
M+105 DAYS+3 MON.	SUBMIT QUARTERLY REPORT ON STATUS OF CA PLAN TO DIRECTOR, CODE QS	APPOINTING OFFICIAL
M+105 DAYS+6 MON.	SUBMIT QUARTERLY REPORT ON STATUS OF CA PLAN TO DIRECTOR, CODE QS	APPOINTING OFFICIAL
	SUBMIT QUARTERLY REPORTS UNTIL ALL ACTIONS HAVE BEEN IMPLEMENTED.	

Figure 1000-1. Schedule for Mishap Reporting, Investigating, Followup, and Closeout for Type A and B Boards

b. General Requirements. The AA for SMA or designees may participate at their discretion as ex-officio nonvoting members in the proceedings of all mishap investigation boards. All other board membership requirements are as follows:

(1) Chairpersons and members of investigation boards are third parties, not directly connected with the operation in which the mishap occurred.

(2) The board chairperson and board members will be Federal employees. Non-Federal employees may serve on boards only as observers, advisors, or consultants but not as board members. The one exception to the non-Federal employee rule is the contractor physician as noted in subparagraph (10). Other non-Federal employees may be excluded from any deliberations at the discretion of the board chairperson.

(3) In exceptional circumstances, board members may be appointed from another Federal agency having technical affiliation with the circumstances of the mishap.

(4) To the extent possible, board members will be selected from personnel who have completed the NASA Mishap Investigation Course or the equivalent. At least one of the board members must have attended the NASA course or equivalent.

(5) Boards will consist of an odd number of members including the chairperson. A minimum of five Federal Employees is required for Type A boards, and a minimum of three Federal employees for Type B boards.

(6) To ensure objectivity, the appointing officials will select the chairperson and where possible, board members from Field Installations, organizations, or programs not responsible to the Installation or the program in which the mishap occurred, except (a) for special cases where the necessary expertise cannot be obtained, or (b) for boards investigating Type C or less serious mishaps where appointments from within the Installation, organization, or program could be made without compromising the integrity of the investigation.

(7) Members of the investigation board shall have sufficient experience and technical expertise to understand the technology and management interfaces related to the mishap.

(8) Local safety and legal personnel will be appointed only as advisors (nonvoting) to the board. This exclusion does not apply to reliability, maintainability, or quality assurance personnel.

(9) The AA for Space Communications, or the Field Installation Public Affairs Director, will designate a qualified Public Affairs Officer to be an advisor (nonvoting) to the board. This person will advise and assist the board in developing and coordinating information to be released to the public in accordance with NASA policies.

(10) A NASA or resident NASA contractor physician will be included as a member or advisor (nonvoting) to the board if the mishap involves death or critical injury. The physician will be a flight surgeon in cases involving flight crews or the use of crew egress equipment.

(11) Board chairpersons, members, and support staff will be relieved of other duties while they are engaged in board activities.

(12) The board chairperson will be empowered to direct or require the conduct of special tests or additional research as needed to support the investigation.

(13) An expert in human factors will be included if human factors are thought to be substantially involved.

(14) Occupational Health personnel shall be included on boards investigating illness and health-related mishaps.

c. Funding. The Program Office or Field Installation serving as host for the Investigation generally will provide funding for board members from other Installations. These funds will be provided from locally available sources, unless provisions to obtain them through other Field Installations or Headquarters sources have been made. The host Installation also will provide administrative and logistical support for the board.

d. NASA Contractor Investigations. Mishaps involving only NASA contractors or contractor-owned equipment/property shall be investigated by the contractor in accordance with contractual requirements, i.e., NFS Clause 18-52.223-70, "Safety and Health," and 18-52.223-73, "Safety and Health Plans," and any additional requirements developed by program or project officials and incorporated in the contract or grant instrument. Contractor board reports will include Corrective Action Implementation Plans and lessons learned. After consultation with the AA for SMA, a decision will be made to accept the contractor's report or to establish a NASA board to review or reopen the investigation. Information about mishaps of lesser severity will be reviewed, at a minimum, by the appropriate program safety officials and Field Installation Safety officials

whose concurrence in contractor corrective action plans is required. NASA personnel may not serve on contractor boards as members, but may participate as advisors or observers.

1007 CONDUCTING THE INVESTIGATION

There are standard procedures of investigation, but the selection and methods of application of these vary with the type of mishap. NHB 1700.1 (V2), "Guidelines for Mishap Investigation," contains detailed information covering all aspects of a mishap investigation. The investigation will be conducted as follows:

a. During rescue and disaster control efforts, the local Installation Director will appoint the Installation Safety Official or others, e.g., emergency response coordinator, to serve as the temporary Official-in-Charge (OIC) of the mishap scene. The OIC will provide initial facts concerning the mishap, rescue, and disaster control efforts to the appropriate Public Affairs Officer for an initial news release. Care should be taken to exclude speculation and limit the released information to the facts only.

b. After the initial emergency has been stabilized, the temporary OIC will preserve evidence, secure the area and control access, identify and take initial witness statements including those from persons involved where possible, and determine the most logical method of proceeding with the analysis of the mishap. The appropriate Installation Director must provide the temporary OIC with the necessary support to accomplish these tasks. Upon arrival, the appointed mishap board chairperson or investigation officer assumes jurisdiction; the temporary OIC will be available to brief and advise on the information gathered to date and the technical assistance available locally. Administrative, communication, and technical support will be provided by the host or nearest NASA Installation, unless other arrangements have been made.

c. The representative from the NASA Safety and Risk Management Division will be present at the first meeting of the board to brief the members on the policies and requirements of NMI 8621.1 and this chapter, and otherwise answer questions concerning the investigation process. This support to the board will continue as requested by the board chairperson. The Safety and Risk Management Division representative also may be the ex-officio member.

d. The chairperson will generally conduct board proceedings in closed session.

e. The appearance of witnesses before the board will be governed by the following guidelines:

(1) In closed session, witnesses will be advised before they testify that the purpose of the investigation is not to determine liability or blame but

the factors relating to the mishap and to prevent mishaps. They also should be advised that their statements and testimonies will be privileged and will not be published with the board report. They also should be advised the Agency will take all legal steps necessary to prevent release of such material to any party; however, it should be recognized that the ultimate decision as to whether such material may be released may reside within a court or administrative body outside NASA.

(2) The board must ensure that witnesses understand that the names of those who testify before the board will be released to collateral investigation boards.

(3) Witnesses will not be asked to testify under oath.

(4) Witnesses will not be allowed to be accompanied or advised by others while testifying.

f. If during the course of the investigation, it is clearly established that the occurrence was caused intentionally (e.g., arson or sabotage), the board chairperson will so advise the appointing official who, at his/her discretion, may terminate the mishap investigation. A collateral investigation board or investigator will be appointed as promptly as possible. The General Counsel and Inspector General will be notified by the appointing official. Evidence such as pictures, records, and logs will be turned over to the collateral investigation team or investigator. Although the names of witnesses will be provided to the collateral investigation team, witness statements and testimony given under promises of confidentiality shall not be released. Such statements shall be placed in a folder, marked as privileged safety board investigation materials, maintained under seal until no longer needed, and then destroyed.

g. If during the course of the investigation, the board determines that a material or other type of deficiency exists that may jeopardize other operations or programs, the board may issue a Safety Bulletin, "SAFALERT", or other notice, or work with the Director, NASA Safety and Risk Management Division, or Director, Occupational Health Office, or the local safety or health official to inform the necessary parties.

h. During the investigation, the chairperson will provide interim reports to the appointing official as requested, but generally on a 2-week schedule. For Headquarters-appointed boards, the chairperson will also provide interim reports to the Director, NASA Safety and Risk Management Division, who will keep the AA for SMA and other Headquarters Offices apprised of progress. The interim reports should briefly describe the activities accomplished and planned by the board and provide a schedule of estimated completion dates.

i. At the conclusion of the board deliberations, the board will prepare its report. Formal board reports will use the revised NASA Form 1388, "Mishap Report Table of Contents" (see Appendix B). Minority opinions, if any, may be submitted by board members and included in the report. The representative from the Office of SMA will provide guidance on proper format requirements.

j. The Administrator may direct the investigation or direct a review of an investigation conducted by others. In this event, the announcement will be made to indicate if other board or review activities convened by lower authorities will continue or be suspended. If other statutory requirements or contract clauses require additional or parallel investigations, provisions will be included to meet such requirements. The Administrator may designate the official who will prepare the necessary documents for initiating and conducting the desired investigation or review. The official so designated will consult with the AA for Policy Coordination and International Relations and the AA for Public Affairs about the desirability and necessity of congressional notification and news releases.

1008 PUBLIC RELEASE OF INFORMATION

a. General. Public release of information about mishaps and mishap investigation reports will be accomplished in accordance with the requirements set forth in NMI 1382.3, "Release of Mishap Investigation Reports"; NMI 1382.4, "Release of Information Concerning Mishaps and Casualties"; and this chapter. Board reports submitted under this issuance should have the following notation on the first page or cover of the report.

> "NOTICE: This document may be exempt from public disclosure under the Freedom of Information Act. Requests for its release to persons outside the U.S. Government should be handled under the provision of NMI 1382.2, "Availability of Agency Records to Members of the Public."

Prior to the release of mishap information or reports, Public Affairs Officers will coordinate with program officials and the Chairperson of the Investigation Board. The Public Affairs Officer also will meet with appropriate legal counsel to establish ground rules necessary to protect the privileged status of witness statements or testimony and other related questions.

b. Congressional Requests. The AA for Policy Coordination and International Relations has the responsibility to convey mishap information and mishap reports through the offices of Congressional Relations, International Relations and Defense, and Intergovernmental Relations.

c. Agreements With Other Organizations. Specific agreements with other agencies and contractors will be followed; however, public announcements by NASA, as stated in the agreements, will require the same coordination as for NASA mishaps prior to release.

d. Agreements With Foreign Governments. When mishaps occur overseas, information will be released by a NASA Public Affairs Officer (PAO). In the absence of a NASA PAO, the AA for Communications will coordinate release of information with the cognizant PAO of a U.S. Military Base or Consular Office in accordance with policies and procedures previously established with the NASA Office of International Relations Division.

e. Department of Labor, Occupational Safety and Health Administration (OSHA) Requests. OSHA requests for information on mishaps should be referred to the AA for External Relations, who will coordinate with the Office of the General Counsel and the AA for SMA.

f. Exclusive Employee Representatives, and Safety and Health Committees. Copies of reports about mishap investigations that involve injury or illness also will be forwarded to appropriate safety or health committees and local exclusive employee representatives, if any, as stated in 29 CFR 1960, "Basic Program Elements for Federal Employee OSH Programs and Related Matters — Department of Labor."

1009 INVESTIGATION BOARD REPORT

The following apply to investigation board reports for both Type A and Type B mishaps, mission failures, and any other mishaps investigated at the Type A or B level.

a. Title of Report will include the nature of the mishap and date of occurrence.

b. Contents

(1) Volume I: The body of the report

(2) Volume II: Appendices

(3) Volume III: Proposed Corrective Action Plan

(4) Volume IV: Lessons Learned Summary

(5) Volume V: Witness Statements and Testimony, Recordings and Transcripts (The original is to be forwarded under separate cover to the Director of the NASA Safety and Risk Management Division. This Volume may not be reproduced.)

Mishap reports for Type C and less severe mishaps and close calls, prepared by a single investigator or investigation team, need not be as extensive as those for major mishaps, but must include, as a minimum, the following essential elements: factual description of events, names of injured and extent of injuries, cause, corrective action plan and schedule, and lessons learned, if appropriate. Names of witnesses and others involved in mishaps but not injured may be recorded in the written report but must not be entered into the MR/CAS data base.

c. Purpose. The purpose of the board report, the associated Proposed Corrective Action Plan, and the Lessons Learned Summary is to document the facts associated with the mishap as determined by the board; determine and identify the primary, contributing, and potential causes; recommend corrective action to prevent recurrence of the specific mishaps; and share lessons learned to prevent recurrence of similar mishaps. The board is tasked with developing a Proposed Corrective Action Plan and a Lessons Learned Summary because of the members' expertise and familiarity with the specifics of the mishap.

d. Schedule

(1) The board report (all volumes) is due to the appointing official within 60 days of the mishap occurrence or as stated in the appointment letter (see Figure 1000-2). The board must not date the report; the date should reflect final acceptance by the AA for SMA. The appointing official has three options upon receiving and reviewing the report:

(a) Accept the report for Headquarters review and comment, either with or without comment.

(b) Return the report and redirect the board. This action would be appropriate if the report did not address pertinent areas or if additional evidence available to the appointing official indicated that the findings of the board were incomplete or incorrect.

(c) With the concurrence of the AA for SMA, dismiss the board and appoint another one. This action would be appropriate only if the board was found unable to deliver a comprehensive or accurate report.

(2) Within 20 days of accepting the report, either with or without comment, the appointing official must develop a formal Corrective Action Implementation Plan, using the board's proposed action plan as a guide. The formal plan must include specific actions, the organizations or individuals responsible for completing the actions, and an estimated completion date for each action and the entire plan. Where actions are required by organizations outside the appointing official's area of responsibility, coordination with the Headquarters Program Director/Manager will be required to obtain the necessary commitment and schedule for implementation. In addition, the appointing official must develop specific lessons learned, using the board's Lessons Learned Summary as a guide, suitable for entry into the NASA Lessons Learned System (the LLIS) (see Appendix B for Lesson Learned Report Form).

(3) Upon completion of the actions delineated above, the appointing official will forward 15 copies of the undated report, the Corrective Action Implementation Plan, and the Lessons Learned Reports to the Director of the NASA Safety and Risk Management Division who will pass the report to the responsible official or staff the report for approval. (Volume V must be forwarded under separate cover and may not be reproduced.)

e. Review, Concurrence, and Publication of Report

(1) The Director, NASA Safety and Risk Management Division, will distribute copies of the report (Volumes I through IV) and the formal Corrective Action Implementation Plan to Headquarters offices for their review and comment. He/she will attempt to resolve any disagreements within 15 days.

(2) The report, the Corrective Action Implementation Plan, and any unresolved issues will then be forwarded to the AA for SMA who will have 10 days to concur, at which time he/she will establish the date of the report. If the AA for SMA does not concur, the report will be returned with comments to the appointing official for reevaluation.

(3) Within 30 days of the concurrence of the AA for SMA, the appointing official will dismiss the board and publish and distribute the report.

1010 FOLLOWUP ACTIVITIES

a. The Corrective Action Implementation Plan will be carried out by the appointing official.

b. The local safety office will track the status of the Corrective Action Implementation Plan.

c. The appointing official will report status of the Corrective Action Implementation Plan quarterly (fiscal year) to the Director, NASA Safety and Risk Management Division. When all actions have been implemented, the appointing official will so certify in writing to the Director, NASA Safety and Risk Management Division, who will then close the mishap file.

1011 MISHAP REPORTING AND CORRECTIVE ACTION SYSTEM AUTOMATED DATA BASE

Each NASA Field Installation Safety Office shall maintain its own MR/CAS data base. Information about all mishaps, mission failures, and close calls, with the exception of damage to contractor-owned equipment and property, off-site contractor injuries, and construction contractor injuries will be entered into this data base. All appropriate information must first be entered on a NASA Mishap Report (NF 1627). MR/CAS data shall be transmitted to the NASA Safety and Risk Management Division at Headquarters on the last workday of each month. A videotape ("Mishap Reporting and Corrective Action System") about the capabilities of the automated MR/CAS is available to supervisors and managers from each facility's Safety Office or training center and the NASA Safety and Risk Management Division. (Information about the operation and implementation of the MR/CAS may be found in Appendix N.)

1012 LESSONS LEARNED

Each Field Installation Safety Office is responsible for reviewing the circumstances surrounding each mishap or close call to determine if other Installations or programs could benefit from the experience gained during the investigation and implementation of the corrective action plan. Each Safety Office will develop lessons learned reports for entry into the automated NASA LLIS. Any contractor or NASA organization also may submit lessons learned to the local SR&QA organization for review and approval. Specific requirements for implementing a lessons learned program will be published separately. (See Appendix B for the Lesson Learned Report form.)

1013 RETENTION OF RECORDS

Each NASA facility must retain mishap reports, investigation reports, and supporting documentation on-site for a minimum of 5 years. Documents will then be archived for an additional 5 years. The records manager at each Field Installation can provide guidance in storing records at off-site locations.

APPENDIX A

REFERENCES

Chapter 1

Executive Order 12196	Occupational Safety and Health Programs for Federal Employees, dated February 26, 1980
Federal Standard 313	Federal Standard for Preparation and Submission of Material Safety Data Sheets
JSC NSTSPM Directive No. 110	Space Shuttle Program (SSP) System Safety Review Panel (SSRP) Charter
KHB 1700.7	Kennedy Space Center Payloads Ground Safety Handbook
NHB 2710.1	Safety and Health Handbook — Occupational Safety and Health Programs
NHB 5100.4	Federal Acquisition Regulation Supplement (NASA/FAR Supplement)
NHS/IH-1845.3	Hazard Communication
NMI 1040.3	Emergency Preparedness Program
NMI 1152.66	NASA Space Flight Safety Panel
NMI 1156.14	Aerospace Safety Advisory Panel
NMI 3810.1	Processing Claims Under the Federal Employees' Compensation Act
NMI 1410.3	Application of the NASA Management Directives System to the Jet Propulsion Laboratory
NMI 1800.4	NASA Occupational Health Program
NMI 5310.2	Participation in Government-Industry Data Exchange Program (GIDEP)
NMI 8070.4	Risk Management Policy for Manned Flight Programs

NMI 8621.1	Mishap Reporting and Investigating
NMI 8710.2	NASA Safety and Health Program
NSTS 1700.7	Safety Policy and Requirements for Payloads Using the Space Transportation System
NSTS 13830	Implementation Procedure for STS Payloads System Safety Requirements
OMB Circular A-119	Federal Participation in the Development and Use of Voluntary Standards
PL 90-67	The NASA Authorization Act of 1968 (Codified as 42 U.S.C. 2477) (see Section 6)
PL 91-596	Occupational Safety and Health Act
QS-EPP-92-001	NASA Emergency Preparedness Plan
10-SMIS-00844	Participation in the Government-Industry Data Exchange Program (GIDEP)
29 CFR 1910	Occupational Safety and Health Administration, Department of Labor (DOL)
29 CFR 1910.1200	Hazard Communication
29 CFR 1960	Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters
29 CFR 1960 Subpart F	Occupational Safety and Health Committees
29 CFR 1960 Subpart G	Allegations of Reprisal
29 CFR 1960 Subpart I	Recordkeeping and Reporting Requirements
29 CFR 1960.26	Conduct of Inspections
41 CFR 101	Public Contracts and Property Management, "Federal Property Management Regulations"

Chapter 2

FAR 42.302	Contract Administration Functions
NFS Subpart 18-1.4	NASA FAR Supplement, Deviations from the FAR
NFS Part 18-23	NASA FAR Supplement, Environment, Conservation, Occupational Safety, and Drug-Free Workplace
NFS Subpart 18-23.70	NASA FAR Supplement, Health and Safety
NFS Subpart 18-23.7004	NASA FAR Supplement, Contract Clause
NFS Part 18-42	NASA FAR Supplement, Contract Administration
NFS Subpart 18-42.2	NASA FAR Supplement, Assignment of Contract Administration
NFS Subpart 18-42.202-70	NASA FAR Supplement, Delegations to Contract Administration Offices
NHB 5100.4	NASA Federal Acquisition Regulation Supplement (NASA/FAR Supplement)
NHB 5300.4(2B-2)	Management of Government Quality Assurance Functions for NASA Contracts
PL 91-596	Occupational Safety and Health Act

Chapter 3

NMI 1410.3	Application of the NASA Management Directives System to the Jet Propulsion Laboratory

Chapter 4

DLAM 8280.1	Specialized Safety Manual
Executive Order 12196	Occupational Safety and Health Programs for Federal Employees, dated February 26, 1980
CS 1.41/3	Federal Personnel Manual (U.S. Civil Service Commission)
NHB 2710.1	NASA Safety and Health Handbook — Occupational Safety and Health Programs

NHS/IH-1845.3	Hazard Communication
NSS/GO-1740.9	NASA Safety Standard for Lifting Devices and Equipment
NSS 1740.XX	NASA Safety Standard for Explosives, Propellants, and Pyrotechnics
5 CFR 532	Code of Federal Regulations, Title 5, Part 532, Prevailing Rate Systems
5 CFR 550	Code of Federal Regulations, Title 5, Part 550, Administrative Personnel, Office of Personnel and Management
29 CFR 1910	Code of Federal Regulations, Occupational Safety and Health Administrations, Department of Labor (DoL)
29 CFR 1910.1200	Hazard Communication
29 CFR 1960	Basic Program Elements for Federal Employee OSH Programs and Related Matters — Department of Labor
29 CFR 1960 Subpart H	Training
40 CFR	Protection of Environment
49 CFR 177	Code of Federal Regulations, Department of Transportation (DOT), Research and Special Programs Administration, Carriage by Public Highway

Chapter 5

NASC Report June 16, 1970	Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations
Presidential Directive/ NSC-25	Scientific or Technological Experiments With Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems Into Space
14 CFR Subpart 1216.3	Procedures for Implementing the National Environmental Policy Act (NEPA)
14 CFR Subpart 1216.305(c)	Criteria for Actions Requiring Environmental Assessments

Chapter 6

AFOSH Standard 161-10	Health Hazard Control for Laser Operations
American Society of Mechanical Engineers	Boiler and Pressure Vessels Code
ANSI A17.1-65/ A17.1-1967	Safety Code for Elevators, Dumbwaiters, Escalators and Moving Walks
ANSI D6.1	Manual on Uniform Traffic Control Devices for Streets and Highways
ANSI Z117.1	Safety Requirements for Confined Space
ANSI Z136.1	American National Standard for Safe Use of Laser
ANSI Z136.2	Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources
DoD Document 316-91	Laser Range Safety
ESMCR 127-1	U.S. Air Force Space Command, Eastern Space and Missile Center Regulation, Range Safety
Executive Order 12566	Safety Belt Use Requirements for Federal Employees
GHB 1771.1	Range Safety
KHB 1700.7	STS Payload Ground Safety Handbook
Manufacturing Chemists' Association, Inc.	Guide for Safety in the Chemical Laboratory, Handling Glassware
MIL-STD 454	Standard General Requirements for Electronic Equipment
NASA Reference Publication 1099	Lithium/Sulfur Dioxide Cell and Battery Safety
NFPA 45	Fire Protection for Laboratories Using Chemicals
NFPA 101	Life Safety Code
NHB 2710.1	Safety and Health Handbook — Occupational Safety and Health Programs
NHB 4100.1	NASA Materials Inventory Management Manual

NHB 4200.1	NASA Equipment Management Manual
NHB 7320.2	Laboratory and Industrial Ventilation
NHS/IH-1845.2	Entry Into and Work in Confined Spaces
NHS/IH-1845.3	Hazard Communication
NHS/IH-1845.5	Occupational Exposure to Hazardous Chemicals in Laboratories
NIOSH 87-113	A Guide to Safety in Confined Spaces
NMI 1710.3	Safety Program for Pressure Vessels and Pressurized Systems
NMI 1700.8	Policy for Limiting Orbital Debris Generation
NMI 1800.4	NASA Occupational Health Program
NMI 3752.1	Delegation of Authority To Take Disciplinary and Adverse Actions
NMI 6000.5	Transportation Management
NMI 7100.8	Protection of Human Research Subjects
NSS/GO-1740.9	NASA Safety Standard for Lifting Devices and Equipment
NSS/WS-1740.10	NASA Safety Standard for Underwater Facility and Non-Open Water Operations
NHB 1700.1(V9)	NASA Safety Manual — Fire Protection
NSS 1740.XX (proposed)	NASA Safety Standard for Explosives, Propellants, and Pyrotechnics
RCC Document 316-91	Laser Range Safety
WSMCR 127-1	U.S. Air Force Space Command, Western Space and Missile Center Regulation, Range Safety
21 CFR	Food and Drugs

21 CFR 1040	Code of Federal Regulations, Food and Drug Administration, Department of Health and Human Services, Performance Standards for Light-Emitting Products
21 CFR 1040.10	Laser Products
21 CFR 1040.11	Specific Purpose Laser Products
29 CFR 1910	Code of Federal Regulations, Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards
29 CFR 1910.97	Nonionizing Radiation
29 CFR 1910.132	General Requirements
29 CFR 1910.133	Eye and Face Protection
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.135	Occupational Head Protection
29 CFR 1910.136	Occupational Foot Protection
29 CFR 1910.137	Electrical Protective Devices
29 CFR 1910.147	Control of Hazardous Energy Sources (Lockout/Tagout)
29 CFR 1910.1030	Bloodborne Pathogens
29 CFR 1910.1450	Occupational Exposure to Hazardous Chemicals in Laboratories
29 CFR 1910 Subpart O	Machinery and Machine Guarding
29 CFR 1910.146	Permit Required Confined Spaces
45 CFR 46	Protection of Human Subjects
49 CFR 171	Code of Federal Regulations, Department of Transportation (DOT), Research and Special Programs Administration, Detailed Hazardous Materials Incident Reports
49 CFR 171.8	Definitions and Abbreviations

49 CFR 172	Code of Federal Regulations, Department of Transportation (DOT), Research and Special Programs Administration, Title 49; Part 172, Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements
49 CFR 172.101	Purpose and Use of Hazardous Materials Table
49 CFR 571	Seat Belt Requirements for Motor Vehicles
49 CFR 571.207	Standard No. 207; Seating Systems
PL 97-258 5 U.S.C 7903	Protective Clothing and Equipment

Chapter 7

GSA Order ADM 5420.99	Interagency Committee for Aviation Policy, dated August 9, 1989
NHB 1700.1 (V2)	Guidelines for Mishap Investigation
NHB 7900.3 (V1)	Aircraft Operations Management Manual
NHB 7900.3 (V2)	Mission Management Aircraft Operations Manual
NMI 8621.1	Mishap Reporting and Investigating
OMB Circular A-126	Untitled
PL 90-67	The NASA Authorization Act, 1968 (Codified as 42 U.S.C. 2477) (see Section 6)
QS-ASO-92-001	NASA Aviation Safety Reference Guide

Chapter 8

EM 385-1-1	U.S. Army Corps of Engineers, Safety and Health Requirements
NHB 2710.1	Safety and Health Handbook - Occupational Safety and Health Programs
NHB 7320.1	Facilities Engineering Handbook

NHB 8820.2	Facility Project Implementation Handbook
NHB 8831.2	Facilities Maintenance Handbook

Chapter 9

NHB 1700.1 (V1-B)	Safety Policy and Requirements Document
NHB 7320.1	Facilities Engineering Handbook
NHB 8060.1	Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion
NMI 1040.3	Emergency Preparedness Program
NMI 8621.1	Mishap Reporting and Investigating
NHB 1700.1 (V9)	NASA Safety Manual — Fire Protection
PL 100-678	Public Buildings Amendments of 1988 (November 17, 1988; Section 6), Compliance With Nationally Recognized Codes
29 CFR 1910 Subpart L	Fire Protection
29 CFR 1910.38	Employee Emergency Plans and Fire Prevention Plans

Chapter 10

NHB 1700.1 (V2)	Guidelines for Mishap Investigation
NFS 18-52.223-70	Safety and Health
NFS 18-52.223-73	Safety and Health Plans
NMI 1382.2	Availability of Agency Records to Members of the Public
NMI 1382.3	Release of Mishap Investigation Reports
NMI 1382.4	Release of Information Concerning Mishaps and Casualties
NMI 3810.1	Processing Claims Under the Federal Employees' Compensation Act

NMI 8621.1	Mishap Reporting and Investigating
OMB No. 1220-0029	Reporting Guidelines for Occupational Injuries and Illnesses
Code QS QS-DOI-91-003	NASA Headquarters Mishap Notification Procedures
29 CFR 1910	Code of Federal Regulations, Department of Labor (DOL), Occupational Safety and Health Standards
29 CFR 1910.217	Mechanical Power Presses
29 CFR 1960	Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters

APPENDIX B

NASA FORMS

The forms in this Appendix are referenced in the NASA Safety Policy and Requirements Document, and are provided for your information.

This page intentionally left blank.

NASA
National Aeronautics and Space Administration

Report of Alleged Unsafe or Unhealthful Working Conditions

FILE NUMBER *(Office use only)*

SECTION I - ORIGINATOR
(See reverse for additional instructions)

LOCATION *(Site of unsafe or unhealthful condition. Installation, building, room, area)*

DATE (Mo., day, year)

DESCRIPTION OF UNSAFE/UNHEALTHFUL CONDITION

PROPOSED CORRECTIVE ACTION *(Optional)*

ORIGINATOR'S NAME *(Optional)*

ORIGINATOR'S PHONE NUMBER

ORIGINATOR'S ORGANIZATION

SECTON II - COGNIZANT SAFETY ORGANIZATION

SAFETY/HEALTH EVALUATION *(Assessment of the condition. Is the hazard valid?)*

CORRECTIVE ACTION TAKEN OR RECOMMENDED

TYPED NAME AND TITLE OF COGNIZANT SAFETY OR HEALTH

RISK CODE

OFFICIAL'S SIGNATURE

DATE

NASA FORM 1659 APR 93

PART 1 - OFFICE OF RECORD PART 2 - OFFICE RESPONSIBLE FOR ACTION
PART 3 - ORIGINATOR UPON CLOSURE

INSTRUCTIONS

SUBMIT THREE COPIES OF THIS FORM TO ORGANIZATION SAFETY OR HEALTH OFFICE

SECTON I - ORIGINATOR

Location, date and description must be completed. Proposed corrective action, name, phone number, and organization are optional.

SECTON II - COGNIZANT SAFETY ORGANIZATION

Upon closure, retain PART 2 for your files and forward PART 3 to the originator, if known.

RISK CODE

The Risk Assessment Code (RAC) is described in NHB 2710.1 and STS 22254 or may be determined as follows:

Severity classification will be identified as follows:

Class I - Catastrophic (may cause death)
Class II - Critical (may cause severe injury, severe occupational illness, or property damage equal to or greater than $25,000)
Class III - Marginal (may cause minor occupational injury or illness, or property damage less than $25,000)
Class IV - Negligible (probably would not affect personnel safety or health but is a violation of specific criteria)

Probability will be estimated as follows:

Estimate A - Likely to occur immediately
Estimate B - Probably will occur in time
Estimate C - May occur in time
Estimate D - Unlikely to occur

Risk Assessment Code (RAC) is a numerical expression of risk determined by an evaluation of both the potential severity of a condition and the probability of its occurrence as follows:

SEVERITY CLASS	PROBABILITY ESTIMATE			
	B	C	D	
II	1	1	2	3
III	1	2	3	4
IV	2	3	4	5
	3	4	5	6

NASA FORM 1659 APR 93 BACK

NASA
National Aeronautics and Space Administration

Notice of Unsafe or Unhealthful Condition

FILE NUMBER

THIS FORM MUST BE POSTED UNTIL THE CONDITION IS ABATED OR FOR THREE (3) WORKING DAYS - WHICHEVER IS LONGER

INSTALLATION

DATE ISSUED *(Mo., day, year)*

LOCATION *(Building/Room/Area)*

DESCRIPTION OF UNSAFE/UNHEALTHFUL CONDITION *(Use reverse if additional space is needed)*

STANDARD, REGULATION OR PROCEDURE VIOLATED

CONDITION IDENTIFIED *(Inspection, complaint, survey, etc.)*

DATE CONDITION IDENTIFIED *(Mo., day, year)*

INSPECTOR'S NAME

INSPECTOR'S PHONE NUMBER

ABATEMENT PLAN DEVELOPED
☐ NO ☐ YES *(Supply Plan No.)*

ABATEMENT TIME *(30 days, 6 mos., etc.)*

RISK CODE *(See reverse)*

INTERIM SAFEGUARDS TO BE UTILIZED *(Safeguards that are in place until the condition is abated, if applicable)*

NASA FORM 1390 APR 93 PREVIOUS EDITION IS OBSOLETE.

CONTINUED

INSTRUCTIONS

CONDITION IDENTIFIED
How did the Safety/Health Office become aware of the condition which required this report? Inspection, complaint, survey, etc.

RISK CODE
The Risk Assessment Code (RAC) is described in NHB 2710.1 and STS 22254 or may be determined as follows:

Severity classification will be identified as follows:
- Class I - Catastrophic (may cause death)
- Class II - Critical (may cause severe injury, severe occupational illness, or property damage equal to or greater than $25,000)
- Class III - Marginal (may cause minor occupational injury or illness, or property damage less than $25,000)
- Class IV - Negligible (probably would not affect personnel safety or health but is a violation of specific criteria)

Probability will be estimated as follows:
- Estimate A - Likely to occur immediately
- Estimate B - Probably will occur in time
- Estimate C - May occur in time
- Estimate D - Unlikely to occur

Risk Assessment Code (RAC) is a numerical expression of risk determined by an evaluation of both the potential severity of a condition and the probability of its occurrence as follows:

SEVERITY CLASS	PROBABILITY ESTIMATE A	B	C	D
I	1	1	2	3
II	1	2	3	4
III	2	3	4	5
IV	3	4	5	6

NASA FORM 1390 APR 93 BACK

NASA National Aeronautics and Space Administration

Safety and Health Hazard Abatement Plan

INSTRUCTIONS ARE ON REVERSE

TYPE OF ABATEMENT ACTION *(Enter title or brief description of corrective action required)*	ABATEMENT PLAN NUMBER

INSTALLATION/PROGRAM OFFICE	BUILDING/LOCATION/AREA

HAZARD DESCRIPTION

STANDARD, REGULATION OR PROCEDURE VIOLATED	RISK CODE

PROGRAM IMPACT

CORRECTIVE ACTION REQUIRED

COORDINATION REQUIREMENTS *(Facilities, GSA, OP and Maintenance Personnel, Program Offices, etc.)*

ESTIMATED COST	FUNDS SOURCE *(R&PM, R&D, or C of F, as applicable)*	ABATEMENT TIME *(30 days, 6 mos., etc.)*

REASON FOR DELAY *(If applicable)*

INTERIM PROTECTION *(if applicable)*

ACTION OFFICER'S TYPED NAME AND TITLE *(Safety or Health Inspector)*

ACTION OFFICER'S SIGNATURE	DATE

CONCURRENCES

SAFETY/HEALTH DIRECTOR	SIGNATURE	DATE
BUILDINGS MANAGER/F.O.M.	SIGNATURE	DATE
FINANCE OFFICER	SIGNATURE	DATE
OTHER *(Specify)*	SIGNATURE	DATE

NASA FORM 1684 APR 93 PREVIOUS EDITION IS OBSOLETE.

INSTRUCTIONS

ABATEMENT PLAN NUMBER
This number is assigned by the Field Installation/Program to identify a particular abatement plan. The format of the number is optional.

INSTALLATION/PROGRAM OFFICE
Enter the cognizant field installation (and project location, if different from the cognizant field installation). For C of F projects include the Headquarters office having advocacy status, as indicated. Refer to pages 25-72 of the Budget Administration Manual for additional information.

RISK CODE
The Risk Assessment Code (RAC) is described in NHB 2710.1 and STS 22254 or may be determined as follows:

Severity classification will be identified as follows:
- Class I - Catastrophic (may cause death)
- Class II - Critical (may cause severe injury, severe occupational illness, or property damage equal to or greater than $25,000)
- Class III - Marginal (may cause minor occupational injury or illness, or property damage less than $25,000)
- Class IV - Negligible (probably would not affect personnel safety or health but is a violation of specific criteria)

Probability will be estimated as follows:
- Estimate A - Likely to occur immediately
- Estimate B - Probably will occur in time
- Estimate C - May occur in time
- Estimate D - Unlikely to occur

Risk Assessment Code (RAC) is a numerical expression of risk determined by the evaluation of both the potential severity of a condition and the probability of its occurrence as follows:

SEVERITY CLASS	PROBABILITY ESTIMATE A	B	C	D
I	1	2	3	
II	1	2	3	4
III	2	3	4	5
IV	3	4	5	6

PROGRAM IMPACT
A statement of justification or need which should cover one or more of the following points:

a. Why the project is now necessary at this location
b. Why current conditions are unacceptable
c. How this project impacts upon other related activities
d. What benefits will accrue
e. What the adverse impact will be if no action is taken.

CONCURRENCES
Include those individuals directly involved in implementing this abatement plan.

SAMPLE TRAINING SCHEDULE

EMPLOYEE TRAINING SCHEDULE 1990 - 1991	NEW EMPLOYEES	ALL EMPLOYEES	MANAGEMENT	SUPERVISORS	C.D. PERSONNEL AND COMMITTEES	EMPLOYEE REPRESENTATIVES
1990 1st QUARTER	LECTURE/ HANDOUTS GIVEN TO NEW EMPLOYEES AT ORIENTATION					
2nd QUARTER		SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT SAFETY RESPONSIBILITIES			
3rd QUARTER				OFFICE SAFETY AND FIRE PROTECTION TO OFFICE MANAGERS	DISTRIBUTION OF SAFETY/HEALTH INFORMATION	DISTRIBUTION OF SAFETY/HEALTH INFORMATION
4th QUARTER		INFORMATION DISTRIBUTED AS PART OF FIRE PREVENTION WEEK ACTIVITIES				
1991 1st QUARTER						
2nd QUARTER		SAFETY TIPS IN NEWSLETTER	OSHA PROGRAM ORIENTATION FOR MANAGEMENT			
3rd QUARTER						
4th QUARTER		INFORMATION DISTRIBUTED AS PART OF FIRE PREVENTION WEEK ACTIVITIES			DISTRIBUTION OF SAFETY INFORMATION	DISTRIBUTION OF SAFETY INFORMATION

SAMPLE TRAINING SCHEDULE

EMPLOYEE TRAINING SCHEDULE 1990 - 1991	LABORATORY WORKERS	MOTOR VEHICLE DRIVERS	MATERIALS HANDLERS	CRAFT WORKERS	OFFICE WORKERS	WORKERS EXPOSED TO BENZENE
1990 1st QUARTER				HAND TOOL SAFETY COURSE		
2nd QUARTER		SAFE DRIVER COURSE				BENZENE HAZARDS COURSE TO AFFECTED WORKERS
3rd QUARTER					SAFETY HANDOUTS GIVEN TO SUPERVISORS FOR DISTRIBUTION	
4th QUARTER	LAB HAZARDS COURSE TO ONE HALF OF LAB WORKERS		MANUAL AND LIFT TRUCK SAFETY INSTRUCTION			
1991 1st QUARTER				MACHINE TOOL SAFETY COURSE		
2nd QUARTER		SAFE DRIVER COURSE				BENZENE SAFETY COURSE TO AFFECTED WORKERS
3rd QUARTER						
4th QUARTER	LAB SAFETY COURSE TO REMAINDER OF LAB WORKERS					

SAFETY/HEALTH CAREER DEVELOPMENT TRAINING PLAN

NAME	TITLE	GRADE
JOHN DOE	SAFETY SPECIALIST	GS-11

PLANNING PERIOD: 1991 - 1992	CONTENT
SUBJECT/COURSE: ACCIDENT INVESTIGATION LOCATION: OSHA TRAINING INSTITUTE DATES: 2/11/91 - 3/15/91	TECHNIQUES OF INFORMATION COLLECTION, ACCIDENT RECONSTRUCTION, CAUSE ANALYSIS, INTERVIEW TECHNIQUES, WITNESS STATEMENTS, TECHNIQUES OF PHOTOGRAPHY.
SUBJECT/COURSE: EXPLOSIVES SAFETY LOCATION: CENTER DATES: 5/13/91 - 8/6/91	CONTENT CORRESPONDENCE COURSE SUPPLIED BY DEPARTMENT OF ARMY COVERING BASIC EXPLOSIVES SAFETY.
SUBJECT/COURSE: AUTOMATIC SPRINKLER SYSTEM LOCATION: HOWARD COMMUNITY COLLEGE DATES: 7/8/91 - 8/2/91	CONTENT COVERS SPRINKLER SYSTEM TYPES AND DESIGN THEORY, HYDRAULIC CALCULATIONS NFPA STANDARD No. 13.
SUBJECT/COURSE: AEROSPACE SAFETY LOCATION: CENTER DATES: 1/15/91 - 3/6/91	CONTENT RESEARCHED LITERATURE TO DEVELOP THE TOPIC FOR A PAPER TO BE PUBLISHED IN A SAFETY JOURNAL.
SUBJECT/COURSE: INDUSTRIAL HYGIENE FOR SAFETY OFFICERS LOCATION: OSHA TRAINING INSTITUTE DATES: (UNKNOWN) FALL, 1991	CONTENT CONCEPTS AND PHILOSOPHY OF INDUSTRIAL HYGIENE. COVERS I.H. FIELD OPERATIONS MANUAL AND EVALUATION OF SELECTED HAZARDS BY USE OF INSTRUMENTS.
SUBJECT/COURSE: LOCATION: DATES:	CONTENT

AUTHORIZATION	TITLE	DATE
	SAFETY DIRECTOR	10/30/91

NASA
National Aeronautics and Space Administration

Telephonic Mishap Report

LOCATION OF MISHAP	DATE OF MISHAP

TIME OF MISHAP	RESPONSIBLE ORGANIZATION *(Contractor name, NASA directorate, etc.)*

MISHAP CATEGORY *(Check as applicable)*

- ☐ TYPE A
  - ☐ FATALITY
  - ☐ DAMAGE
- ☐ TYPE B
  - ☐ HOSPITALIZATION
  - ☐ DAMAGE
- ☐ TYPE C
- ☐ MISSION FAILURE
- ☐ CLOSE CALL POTENTIAL:
  - ☐ TYPE A
  - ☐ TYPE B
  - ☐ TYPE C
  - ☐ INCIDENT

PROPERTY/EQUIPMENT DAMAGED *(e.g., flight hardware, GSE, aircraft, wind tunnel, etc.)*

DESCRIPTION OF MISHAP *(Sequence of events, personnel involved, extent of injuries, cause, if known, etc.)*

PROGRAM IMPACT	DAMAGE COST *(Estimated)*

TYPE OF INVESTIGATION *(If none, so state in this block)*

☐ INVESTIGATION BOARD *(List names)* ☐ INVESTIGATION TEAM *(List names)* ☐ INVESTIGATOR

INFORMATION SUBMITTED BY *(Name, organization, phone number)*

COMMENTS

ORGANIZATIONS NOTIFIED

RECEIVED BY *(Signature)*	DATE AND TIME

LESSON LEARNED REPORT

1. LESSON NUMBER (PROVIDED BY SYSTEM)	2. DATE	3. FACILITY ID

4. SUBJECT

5. LESSON LEARNED

6. ACTION REQUIRED

7. SUBMITTED BY	8. ORGANIZATION	9. PHONE NO.

SOURCE INFORMATION

10. SOURCE NO.	11. REPORTING FACILITY	12. SOURCE DATE

13. DESCRIPTION OF DRIVING EVENT (Attach additional sheets if necessary)

14. EVIDENCE OF RECURRENCE CONTROL EFFECTIVENESS (Attach additional sheets if necessary)

APPROVAL & CONCURRENCE

15. TECHNICAL REVIEW AND APPROVAL

Print or type name	Signature	MAIL CODE	PHONE NO.

16. SR&QA CONCURRENCE

Print or type name	Signature	MAIL CODE	PHONE NO.

CODE QS MAR 93 v3.0P

LESSON LEARNED REPORT

INSTRUCTIONS: THE MOST IMPORTANT ASPECT OF A LESSON LEARNED IS THE ACTION(S) THAT SHOULD BE TAKEN TO PREVENT A MISHAP, FAILURE OR LOSS OF ANY KIND (BLOCK 6). EACH ACTION OR LESSON MUST BE SUBMITTED ON A SEPARATE REPORT FORM. IF YOU ARE SUBMITTING SEVERAL LESSONS DERIVED FROM THE SAME SOURCE OR SEVERAL ACTIONS FROM THE SAME LESSON, FILL OUT THE SOURCE INFORMATION ON ONLY ONE OF THE REPORT FORMS. THE INFORMATION YOU PROVIDE WILL BE ENTERED INTO THE AGENCYWIDE LESSONS LEARNED INFORMATION SYSTEM (LLIS). LEAVE ANY ITEM BLANK IF NOT APPLICABLE UNLESS REQUIRED.

1. THE AUTOMATED SYSTEM WILL GENERATE THIS NUMBER.

2. PROVIDE THE DATE THIS LESSON IS WRITTEN.

3. PROVIDE THE ID OF THE NASA FACILITY THAT IS PREPARING THIS LESSON: ARC, GSFC, HQ, JPL, JSC, KSC, LARC, LERC, MSFC, SSC. IF SSF PROGRAM OFFICE, USE SSPO. (REQUIRED)

4. SPECIFY THE SUBJECT OR TOPIC OF THE LESSON, E.G., RANGE SAFETY, DEVIATIONS/WAIVERS, TEAR DOWN PROCEDURES, BOLT INSTALLATION, ELECTRICAL HARNESS WIRE INSULATION, ETC.

5. BRIEFLY EXPLAIN THE LESSON LEARNED INCLUDING THE RISK TO BE ELIMINATED OR MITIGATED.

6. BRIEFLY STATE THE ACTION THAT SHOULD BE TAKEN TO ELIMINATE OR MITIGATE THE RISK.

7.-9. PROVIDE YOUR NAME AS SUBMITTER OF THIS LESSON, THE NAME OF YOUR ORGANIZATION AND YOUR PHONE NUMBER (REQUIRED)

10. PROVIDE THE NUMBER OF THE SOURCE DOCUMENT THAT DESCRIBES THE EVENT FROM WHICH THIS LESSON WAS DEVELOPED.

11. PROVIDE THE ID OF THE FACILITY THAT REPORTED THE TRIGGERING EVENT AND HAS POSSESSION OF THE SOURCE DOCUMENT.

12. PROVIDE THE DATE OF THE SOURCE DOCUMENT (NOT THE DATE OF THE DRIVING EVENT).

13. BRIEFLY DESCRIBE THE DRIVING EVENT OR PROBLEM THAT RESULTED IN THE DEVELOPMENT OF THIS LESSON. ATTACH ADDITIONAL SHEETS IF NECESSARY.

14. BRIEFLY DESCRIBE THE EVIDENCE THAT THE ACTION REQUIRED (STATED IN 6.) IS EFFECTIVE IN CONTROLLING THE RECURRENCE OF THE DRIVING EVENT(s). ATTACH ADDITIONAL SHEETS IF NECESSARY.

15.-16. FOR DATA MANAGEMENT USE ONLY.

MISHAP REPORT TABLE OF CONTENTS

VOLUME I

VOLUME II
APPENDICES

VOLUME III
PROPOSED CORRECTIVE ACTION PLAN

VOLUME IV
LESSONS LEARNED SUMMARY

*VOLUME V
WITNESS STATEMENTS/TESTIMONY
RECORDINGS/TRANSCRIPTS

*TRANSMIT UNDER SEPARATE COVER TO THE DIRECTOR, SAFETY DIVISION.
PRIVILEGED INFORMATION - DO NOT DUPLICATE OR DISTRIBUTE.

NASA FORM 1396 OCT 89 PREVIOUS EDITIONS ARE OBSOLETE

This page intentionally left blank.

APPENDIX C

SENIOR SAFETY STEERING COMMITTEE CHARTER

PURPOSE

This charter establishes a Senior Safety Steering Committee that can respond to NASA Safety concerns. The Senior Safety Steering Committee shall provide a forum to address and investigate system and industrial safety issues that cannot be resolved at the local safety levels and to facilitate appropriate resolutions Agencywide. An advisory council of selected NASA non-safety senior managers may be used to enhance resolution procedures and enactment.

MEMBERSHIP

The Senior Safety Steering Committee is an adjunct to the NASA Headquarters SRM&QA community. The Senior Safety Steering Committee membership will comprise senior installation safety management personnel from the following NASA organizations: Johnson Space Flight Center, Kennedy Space Flight Center, Marshall Space Flight Center, Goddard Space Flight Center/Wallops Flight Facility, Lewis Research Center, Langley Research Center, Stennis Space Flight Center, Jet Propulsion Laboratory, Ames Research Center/Dryden Flight Research Facility, NASA Space Station Division (Code QF), NASA Safety and Risk Management Division (Code QS), and the Headquarters Personnel Division (Code FP). The members of the advisory council will be appointed by Code QS and the Center directors as required.

SCOPE

Committee efforts shall be directed toward expediting general policy formulation and resolution of common safety issues. The final implementation or application of requirements shall remain the responsibility of individual Centers and program safety personnel.

WORKING GROUPS

Senior Installation safety managers or appointed safety representatives who form the Steering Committee will organize and participate in standing working groups and ad hoc working groups to address issues and problems that cannot be resolved by local safety management, have been referred to the working groups, or require additional resources. Standing working groups shall comprise senior Installation safety managers or appointed safety representatives that have the expertise and experience to address the issues and problems within the scope of the group.

Issues and problems that are outside the scope of a standing working group and require special attention shall be handled by an ad hoc working group formed especially to address those issues or problems. Selected topics and issues resolved, addressed, or

requiring the attention of top-level management will be presented by the Senior Safety Steering Committee to the Headquarters Safety and Mission Assurance Directors meeting as appropriate.

MEETINGS

Senior Safety Steering Committee meetings will convene annually and be chaired and scheduled by NASA Safety and Risk Management Division. A meeting announcement and agenda will be published 30 days before the scheduled meeting. Standing working group and ad hoc group chairpersons will schedule video teleconferences/teleconferences, as necessary, to work and resolve issues under investigation. Meeting schedules are subject to changes as required to accommodate specific unforeseen program events.

APPENDIX D

SAFETY MOTIVATION AND AWARDS PROGRAM

1. The following awards represent NASA's primary means for recognizing outstanding safety performance:

   a. NASA Honor Awards. These awards are approved by the Administrator and represent the highest honorary recognition bestowed by NASA. Federal and non-federal personnel making significant safety contributions may be nominated for these awards following the guidelines provided in NMI 3451.1, "The NASA Awards and Recognition Program."

   b. NASA Safety and Risk Management Division (Code QS) Awards. This awards program is administered by the NASA Safety and Risk Management Division. It is specifically designed to recognize and encourage significant achievements and initiatives by NASA personnel in program and operational safety. Details of this program are outlined in subparagraph 4.

   c. NASA Space Flight Safety Award. This award is managed by the Space Flight Safety Panel in accordance with NMI 1152.66, "NASA Space Flight Safety Panel." It is bestowed in recognition of contributions to flight safety made through design, device, or practice. The purpose of the award is to acknowledge the individuals whose personal efforts, above and beyond their job commitment, result in significant, direct contributions to flight safety. The award is given to both individuals and groups. Every Government and industry employee supporting NASA's manned space effort is eligible for this award.

   d. Field Installation Safety Awards. The majority of NASA safety awards are issued at the local level as part of each Installation's overall safety effort. Safety programs at NASA Field Installations shall include an awards program, designed in accordance with this document, to recognize and encourage safety in all operations.

2. NASA safety awards shall be properly designed to motivate and maintain safe behavior. The following principles shall be considered when developing safety awards:

   a. Individual awards are generally more effective than group awards. The monetary value of the award is relatively unimportant. Expensive awards may, in fact, foster competition and ill feelings that defeat the purpose of the program. The most appropriate award is one that individuals can keep and display.

b. The manner in which the award is presented is as important as the award itself. The award should be presented publicly to effectively satisfy the individual's/group's need for recognition and to provide an incentive for other personnel.

c. Any award based on competition must be carefully designed to avoid possible negative aspects. (For example: Employees involved in a competition to reduce on-the-job injuries have been known to avoid seeking medical attention for an injury so that it would not be reported.)

d. The safety awards program should be part of the participating safety program and include all personnel.

e. Award presentations and the safety contributions made by award recipients shall be sufficiently publicized to heighten employee safety awareness and to encourage active employee participation in all efforts designed to improve safety performance.

f. Awards shall be granted on the basis of merit without regard to age, color, handicap, marital status, national origin, politics, participation or nonparticipation in a labor organization, race, religion, or sex.

g. NASA awards for safety excellence shall be granted based on specific published criteria. Nominations shall be evaluated against the individual awards criteria and not against any unwritten standards or interpretations.

3. In conjunction with safety awards, NASA safety programs may distribute items of minimal value to individuals as a means of promoting safe work practices and heightening safety awareness. The following apply to the purchase and distribution of safety promotional items:

a. Procurements made with Federally appropriated funds are subject to the rulings of the General Accounting Office (GAO). Safety promotional items usually are interpreted by GAO as personal gifts, and therefore have not been allowed. It is recommended that nonappropriated funds be used for the procurement of safety promotional items whenever possible.

b. Safety promotional items shall be distributed for valid reason and shall not be given with such frequency that they lose meaning.

c. The responsible NASA safety organization shall clearly define the purpose of each award, those who are eligible, and the criteria for selection.

d. All items shall be clearly identified as NASA safety program items via printed markings and/or safety logos.

4. The NASA Safety and Risk Management Division Awards Program is designed to recognize and encourage significant achievements in program and operational safety at NASA Field Installations. This program also encourages and augments the Field Installations' own safety awards programs through recognition of individuals/groups that have made significant contributions to safety and by providing funding/awards materials for use by the Installations. The NASA Safety and Risk Management Division Awards shall be presented annually for performance during each fiscal year.

a. The Safety and Risk Management Division Awards Committee is responsible for the administrative direction, operation, and evaluation of the Safety and Risk Management Division Awards Program. Typically, the Committee shall perform the following functions:

(1) Establish annual awards evaluation criteria, including performance goals for each Installation.

(2) Publish the awards criteria and goals for a given fiscal year and distribute appropriate awards applications during the second quarter of that year.

(3) Evaluate awards applications and select awards recipients.

(4) Review overall effectiveness of the awards program. (Annual publication of awards criteria allows for program adjustments and provides the flexibility needed to address issues of special interest for a given year.)

Committee membership is as follows:

Chairperson:	Director, Safety and Risk Management Division (Code QS)
Members:	Deputy Director, Safety and Risk Management Division
	Chief, Operational Safety Branch
	Manager, Operational Safety
	Manager, Headquarters Safety Information System

(Additional members may be appointed on an ad hoc basis at the Chairperson's discretion to augment the Committee's composition as required.)

b. Awards. There are two categories of Safety Division awards: one for NASA Field Installation safety programs (includes the Jet Propulsion Laboratory) and one for NASA and contractor employees.

(1) Outstanding Safety Program award is designed to encourage and recognize safety program excellence at the Field Installation level. An appropriate plaque and awards materials will be presented to those NASA Installations whose overall safety performance is outstanding in one of the following areas:

(a) Improvement.

(b) Sustained performance.

(c) Performance in the award year.

To be eligible for an award, each Field Installation safety office must submit a completed awards application to the Awards Committee. Each Field Installation will be required to perform a self-evaluation and to provide data on various safety parameters and issues, e.g., lost time frequency rates, property damage, compliance with OSHA and NASA safety policies, extent and effectiveness of the Installation's safety motivation program, and any other issues identified by the Committee for that year. Awards recipients will be selected based on their application, data obtained during safety audits, and data from the NASA Safety Information System. The number of awards and the performance areas recognized will be at the discretion of the Awards Committee.

(2) Individual/Group Awards recognize field personnel (NASA or contractor) who have made significant achievements contributing to the success of NASA's Safety Program. To be eligible for an award, the individual/group must be nominated by the Field Installation Safety Director, and a completed awards application must be submitted to the Awards Committee. An appropriate plaque and awards materials will be presented to the individuals/groups selected by the Awards Committee. The number of awards presented will be at the discretion of the Committee.

APPENDIX E

SAFETY PROGRAM PLAN

The Safety Program Plan(s) (SPP's) will detail how the contractor or NASA organization (if applicable) will implement and comply with the program Safety Management Plan (SMP) or other safety task requirements from the Request for Proposal (RFP). The plan shall be updated to reflect major changes in the scope or objectives of the Program. The Safety Program Plan may be combined with the Health Plan at the direction of the contracting officer.

The following provides a tailorable outline of information, based upon the contract, to be included in the contractor SPP.

1. Safety Program Policy. State policy and program goals concerning safety and loss prevention, and commit management to safety of personnel and property and to compliance with NASA and OSHA requirements.

2. Scope of Safety Program Plan. State the intended operations and services under the contract, locations of performance, and all employees covered, including contractor, subcontractor, supplier, consultant, and Federal Agency personnel.

3. Safety Program Organization and Structure. Provide a chart explaining the safety management and safety engineering services organization and its relationship (interfaces) with other functional elements and disciplines for performance of the contract. Include the organizational lines of communication: internal to the contractor, subcontractor, or supplier, and external to the Contracting Agency and other agencies involved for all intended safety program activities. Also, identify all key personnel and the organizational elements that will provide safety-oriented services or exercise control in safety matters.

4. Responsibility and Authority of the Safety Organization. Identify the organizational elements, groups, or committees responsible for safety program functions and deliverables. Detail the authority of these elements to resolve identified hazards and unsafe conditions. List, by title, the specific safety roles and responsibilities to be assigned to individuals.

5. Safety Program Management and Implementation. Identify the procedures, techniques, methods, and documentation (e.g., NASA, other Federal or National Consensus Standards, or internal) that will be used to manage all safety requirements during contract performance. When applicable to the scope of the contract as determined by the Contracting Officer, include the following:

    a. Assignment of responsibility and designation of methods for identification and control of internal and external hazards, e.g., hazard analyses/risk assessment, associated with work performed under this contract. Identify

methods for constraining/stopping activities (Red Tag authority) pending correction/closure of open hazards. Identify the relationship between the various safety analyses such as hardware design analysis, Operating and Support Hazard Analysis (O&SHA), and process/planning procedures to ensure safe performance of operations.

b. Identification of methods to ensure development of written procedures for all hazardous operations, including testing, construction, maintenance, and repairs, in the detail required for safe task performance. Procedures will be developed in a format suitable to become part of the safety manual used during the applicable contract.

c. Identification of methods to ensure that documentation setting forth inspection procedures, test procedures, and other related information identifies the relevant hazardous situations and includes proper cautions and notifications to affected employees.

d. Identification of responsibility for training every employee to understand safe work practices, safety hazards communication, hazard recognition and reporting, and appropriate protective measures. Training will be provided and documented in accordance with NASA and OSHA requirements.

e. Details for training and certification of personnel who will perform functions that have been determined to be hazardous by the contractor or the Government agency with the Government agency as final authority. Certifications include documentation on training requirements and physical conditions that have been satisfied by examination, testing, on-the-job performance, or other comparable methods.

f. Assignments, procedures, and frequency for regular inspection and evaluation of work areas for hazards and accountability for implementation of corrective measures.

g. Responsibilities and methods for internal audit and evaluation of the overall safety program. Also, identification of personnel who conduct the audit and evaluation and who receive the report, and the frequency (at least annually) with which internal audit is performed. These evaluations will include subcontracted activities.

h. Procedures for mishap reporting and accident investigation, implementation of corrective actions, and development of lessons learned.

i. Establishment of administrative procedures and responsibility for emergency preparedness plans and procedures.

j. Details of the safety program for facilities, hardware, or software item acquisition that include various provisions to assure that facilities designed

and built under the contract comply with all applicable safety requirements of NASA and consensus standards. These provisions also assure that the resulting facilities will provide a safe workplace. Safety program inputs and deliverables at various milestones during a development or procurement cycle should be included.

k. Details of controls to ensure that (1) safety tasks are included in subcontracts and (2) procurement requests are reviewed for safety considerations and that specifications contain appropriate safety criteria and instructions.

l. Details of control over the program for handling hazardous materials that involve safety aspects (e.g., storage, labeling, issue, use, and disposal).

m. Responsibilities and procedures for procurement, inspection, and maintenance of safety protective clothing and equipment.

n. Details of the safety waiver program.

o. Details of the safety motivation and awareness program.

p. Provisions for an operational readiness program structured to provide an in-depth technical and programmatic safety review, by appropriate disinterested individuals with technical expertise, of (1) major or high-hazard facilities prior to activation and (2) transportation and handling operations involving program-critical hardware or significant risk of damage or injury prior to the operation.

6. Safety Program Milestones. Provide a schedule and milestones for all major program phases/activities and the related safety program deliverables over the duration of a contract, showing start and completion dates. Relate these schedules to overall Program milestones that each safety task supports including other program functions (interfaces) specified as engineering efforts elsewhere in the contract. Show the documented safety deliverable data milestones, as applicable, for:

a. Functional requirements and concept development.

b. Preliminary design and material selection.

c. Intermediate/final design.

d. Procurement.

e. Manufacturing/construction.

f. Test, validation, and acceptance.

g. Operations/maintenance.

h. Disposal/retirement.

7. Safety Program. The Safety Program activities and life cycle phases also cover an equipment or system throughout its complete usable life. Although the phases of this program often are presented differently than the eight phases and milestones outlined in the previous paragraph, they cover the same activities. See Figure E-1, "The NASA Acquisition Life Cycle (Safety)," for an illustration of the system life cycle.

8. Analysis Techniques. Appendix H of this document provides the safety analyses and the tools and techniques used in the hazards analysis process of the acquisition life cycle for hardware and facilities.

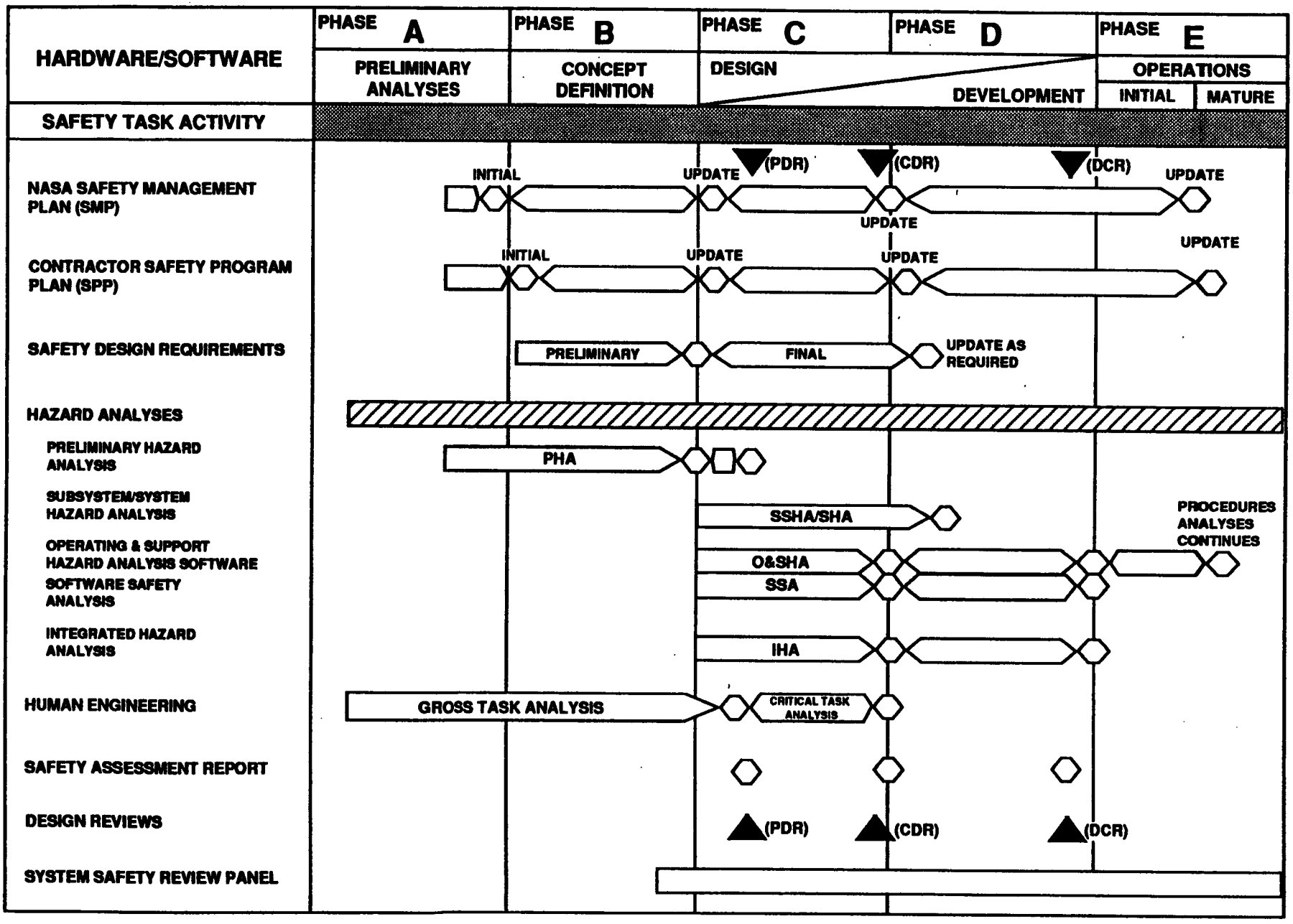


Figure E-1. NASA Acquisition Life Cycle (Safety)

This page intentionally left blank.

APPENDIX F

PROGRAM SAFETY MANAGEMENT PLAN

The NASA Program Manager will publish and maintain an approved Safety Management Plan (SMP), appropriate to and for the life of the program. This plan may be incorporated in the more comprehensive Safety and Mission Assurance (SMA) plan, mission assurance plan, etc., providing the required data are identifiable and complete.

1. The SMP defines the objectives, responsibilities, and methods to be used for overall safety program conduct and control. Integration of system/facility safety provisions into the SMP is vital to the early implementation and ultimate success of the safety effort. Inclusion of these provisions in the Plan will send an unmistakable message to all program participants that safety is an integral part of the management process and all tasks. The authority to conduct the safety program must originate in the respective SMP governing each NASA program.

2. The NASA program SMP shall be the vehicle for safety task planning. The Plan will include detailed task requirements for the system safety task as tailored from this document for the Program. The NASA program organization and system safety relationships and responsibilities will be described along with reporting channels for this task. In particular, the plan will show how NASA safety will manage its independent oversight role. The plan will stipulate hazard analysis methodologies, Hazard Report (HR) data and format requirements, and the approval reporting channels for HR's and their milestones. It will address requirements for NASA and contractor participation in design, safety, and readiness reviews. The program SMP shall be a compliance document in the Request for Proposal (RFP). Data requirements for the program SMP are in the Data Requirements Document. For a multi-Field Installation program, each Field Installation should supplement the plan to ensure its compatibility with the Field Installation organization and ability to comply with task requirements.

3. The level of safety directly correlates with management's emphasis on the safety of the system/facility being developed. Proper identification of the system/facility safety program elements is the first step towards developing a successful program. Each functional safety program has the following 10 basic elements:

   a. Planning.

   b. Organization.

   c. Contracting.

   d. Interface/Coordination.

   e. Requirement.

f. Analysis.

g. Risk assessment.

h. Reporting.

i. Mishap investigation.

j. Data retention.

4. Each of these elements is aligned with an overall approach to risk evaluation by:

a. Identifying system/facility safety hazards.

b. Determining corrective actions to either eliminate or control the safety hazard.

c. Recommending corrective action or alternatives to the appropriate management level for a decision to either eliminate the hazard or accept the risk. Residual risk acceptance may be handled at varied levels. The higher risks must be accepted by the Program Manager.

d. Documenting those areas in which a decision has been made to accept the risk, including the rationale for the risk acceptance.

5. During the Concept Phase, appropriate safety tasks should be planned that will become the foundation for safety efforts during the system definition, design, manufacture, test, and operations.

a. Identify special safety studies that may be required during system definition or design.

b. Estimate gross milestone personnel requirements for the safety program during the complete system life cycle.

c. Perform trade studies by using the result of the preliminary hazard analysis that identified highly hazardous areas, with recommended alternatives.

d. Establish safety goals and objectives to determine the type of safety input for the overall program.

(1) Goals should be measurable and state what would be accomplished by performing the various safety tasks.

(2) Goals should be structured so that safety tasks can be selected to accomplish them.

(3) Task results should clearly demonstrate that the goals have been met.

e. Complete preliminary hazard analyses to identify potentially hazardous systems and to develop initial safety requirements and criteria.

f. Review the gross hardware requirements and concepts to maintain an understanding of the evolving system.

g. Review pertinent historical safety data from similar systems.

h. Require a complete, integrated contractor Safety Program Plan (SPP).

This page intentionally left blank.

APPENDIX G

HAZARD REPORTS

Hazard Reports (HR's) for safety hazards shall be written prior to each major milestone to document residual risks identified in the hazard analysis process against program requirements. The HR is a tool by which residual risks are identified in such a manner that each level of technical management in a program can evaluate the risks and formally accept them based on documented rationale. HR's will be updated to reflect program changes and modifications that affect the identified risk. Specific data requirements will vary among programs, but the HR data elements within a program will be standardized. The following is recommended as a minimum data element set. This process is not intended to apply to those Federally mandated requirements, e.g., OSHA, DOT, FAA, etc.

1. Report Number. Each HR will be given a unique alpha-numeric number that identifies the system/subsystem for which it is written. Provision will be made for a revision letter and Document Control Number (DCN).

2. Date. Date of preparation/revision of the HR.

3. Status.

   a. Closed: Corrective action to eliminate or control the hazard has been implemented or scheduled for implementation before the effectivity identified in the HR. Program management accepts the risk pending completion of corrective action and verification. Baselining (written approval of the HR within the configuration management system) is required to approve a HR as closed.

   b. Open: An HR status is open when corrective action to eliminate or control the hazard has not been completed, and the corrective action is not scheduled to be performed.

4. Title. Provide a short descriptive (not generic) title for the hazard.

5. System. Identify the system/subsystem/component at the level at which the hazard is being written.

6. Effectivity. This element helps to narrow and define the applicability of the hazard. It will vary by type of program and could be specific to a test, flight, or vehicle. It could also be applicable to a series (or fleet) of tests, vehicles, or flights.

7. Operation Phase. A discrete period defined by the program for tests or operations during which the hazard could occur. A hazard could occur during one or more phases such as prelaunch, stage one, on-orbit, recovery, etc.

8. Description of the Hazardous Condition. Describe the condition which can/will lead to loss of flight or ground personnel, loss of safety-critical system, loss of life or injury to the public, loss of equipment/flight vehicle, or loss of public property. The hazardous condition shall be described in terms of one or more generic hazards, such as fire/explosion, impact, etc. The description should explicitly specify the equipment involved, e.g., "Impact between separating upper stages could results in loss of trajectory control for final stage."

9. Risk Acceptance Rationale. Provide a brief summary of the technical rationale for accepting the residual risks identified in the HR.

10. Submittal Signatures. The specific signatures required on a HR will vary with the size of the program and whether it is contracted or performed in-house at NASA. The following signatures should be required as a minimum:

    a. Originating activity design engineer.

    b. Originating activity Safety Engineering Manager.

    c. Assigned NASA Field Installation System/Subsystem Engineer.

    d. Assigned NASA Field Installation Safety Engineer.

11. Risk Assessment Section. The risk assessment section of the HR comprises several linked data elements. These are: cause(s), effect(s), safety requirements, control(s), verification(s), classification, severity, and likelihood of occurrence. While an HR is generated to address one hazardous condition, the condition may result from several related or mutually exclusive hazard causes. In turn, each cause could result in multiple effects and multiple safety requirements. Multiple controls may be required to control the cause, the effect, or both, and each control may use several verification methods to assure the control is in place. Each discrete effect, safety requirement, and control will be hard-linked to its cause, and each discrete verification method will be hard-linked to its control. Based on the data, the risk (severity and likelihood of occurrence) will be assessed for each cause, and the cause will be assigned a classification based on the risk. For each hazard cause, the worst case effect will determine the severity level to be assigned. For each hazard cause, the controls that are in place are assessed to determine the likelihood of occurrence from the program risk assessment matrix; when the likelihood of occurrence has been derived using probabilistic methods, the numerical probability will be used. Eliminated hazard cause will not be documented in this part of the HR, but should be included in background data to maintain visibility of improvements made during the hazard analysis and reporting

process. The assigned reference number of the eliminated cause and linked data will not be deleted, but will be annotated as "Eliminated."

a. Causes: Unsafe acts or conditions that may lead to the hazardous event. Hazard causes shall be identified down to the level at which controls are to be applied and shall consider environments, hardware failures, secondary failures/conditions, software errors, procedural errors, operationally induced external and internal failures, and human errors/limitations. In addition to the program engineering and operations data, generation of the causes and linked data should consider waivers and deviations with safety impact; test, processing and operational problems/anomalies; alerts, trending data; and interface/integrated hours.

(1) Effect(s): The effect(s) is/are the potential worst case outcomes of the hazard cause.

(2) Requirement(s): Provide narrative descriptions of the requirement(s) that define criteria to be met when controlling the hazard. In addition to listing safety requirements used to control the hazard, provide other requirements used to control each cause and effect. The reference must include document number and title. The lowest level requirements should be used as primary references and the higher level requirements as secondary priority.

(3) Control(s): Provide narrative description(s) of the appropriate design, safety devices, alarm/caution and warning devices, or special automatic/manual procedures used to control the hazard. Documentation references by document number and title are required for each control.

(4) Verification(s): Identify the method(s) used to verify the hazard control(s). Verification methods include analyses, tests, inspections, and operations and maintenance requirements. Verification reference documents will be identified by number and title. Procedures and/or specifications will be referenced to document verification.

(5) Severity: This part of the HR is completed for each cause by assessing the most severe effect and documenting it as catastrophic, critical, or marginal. See the Glossary for definitions of the severity terms.

(6) Likelihood of Occurrence: This part of the HR is completed for each cause.

(a) When probabilistic risk assessment methods are used, list the numerical probability of occurrence for this cause.

(b) When qualitative risk assessment methods are used, the controls that are in place must be assessed and documented for likelihood of occurrence in accordance with the defined program risk assessment matrix. It is recommended that the following likelihoods and definitions be adopted.

1 Probable: Expected to happen in the life of the program.

2 Infrequent: Could happen in the life of the program. Controls have significant limitations or uncertainties.

3 Remote: Could happen in the life of the program, but not expected. Controls have minor limitations or uncertainties.

4 Improbable: Extremely remote possibility that it will happen in the life of the program. Strong controls in place.

(7) Classification. Each hazard cause will be assigned a classification of controlled, accepted risk, or (extremely rare) unacceptable risk. A risk of the latter magnitude should never reach the HR baseline stage, but provision is made for its use when the HR is used for information reporting. See the Glossary for definition of the classification terms.

b. Overall HR Risk Assessment and Closure:

(1) Quantitative:

(a) The quantitative approach involves the use of probabilistic risk assessment methods to compute the risk probability for the hazard.

(b) A numerical probability alone may not be sufficient to make the a closure determination. Extremely low probabilities are easy to call, but higher probabilities may require further controls. The program shall devise a method/policy for determining closure.

(2) Qualitative:

(a) When qualitative risk assessment methods are used, a risk picture, using a program-defined risk assessment matrix, shall be included as part of the HR and presented to program management as a check to ensure the proper severity and likelihood of occurrence. An example of the risk picture is shown in Figure G-1, which uses the severities and suggested likelihood of occurrence definitions from Appendix O. The risk matrix will be completed by documenting each hazard cause severity and likelihood of occurrence in the appropriate block. The controls are considered to be in place when the matrix is marked.

(b) Hazard closure classifications will be either eliminated, accepted as is, or controlled. Unacceptable risks require reduction prior to HR baselining and are a constraint to tests and operations.

12. Interfaces. Identify system interface(s) that are affected by and cause hazard conditions within the report, including facilities, Ground Support Equipment (GSE), and other parts of the program.

13. References. The HR will contain pertinent reference information to other program documentation that affect, and are affected by data elements within the HR. These will include, but are not limited to, FMEA/CIL, requirement and specification documents, procedures, test and operational limitation and criteria rules, and flight rules.

14. Background/Remarks. Include information that increases understanding of the hazard, describes changes to the hazard, and identifies supportive documentation, etc. Use it to document the chronology of major events associated with the hazard, including related flight history, test and check-out, failure summaries, changes to the design or operation, etc.

15. Status of Open Work. Identify open work, responsible agency, action required, and the due date. Completion due dates will be supplied only for open work that is a constraint to a critical milestone in the program.

16. Preparing Engineer and Date. Identify the preparing engineer/analyst and the date the HR was prepared.

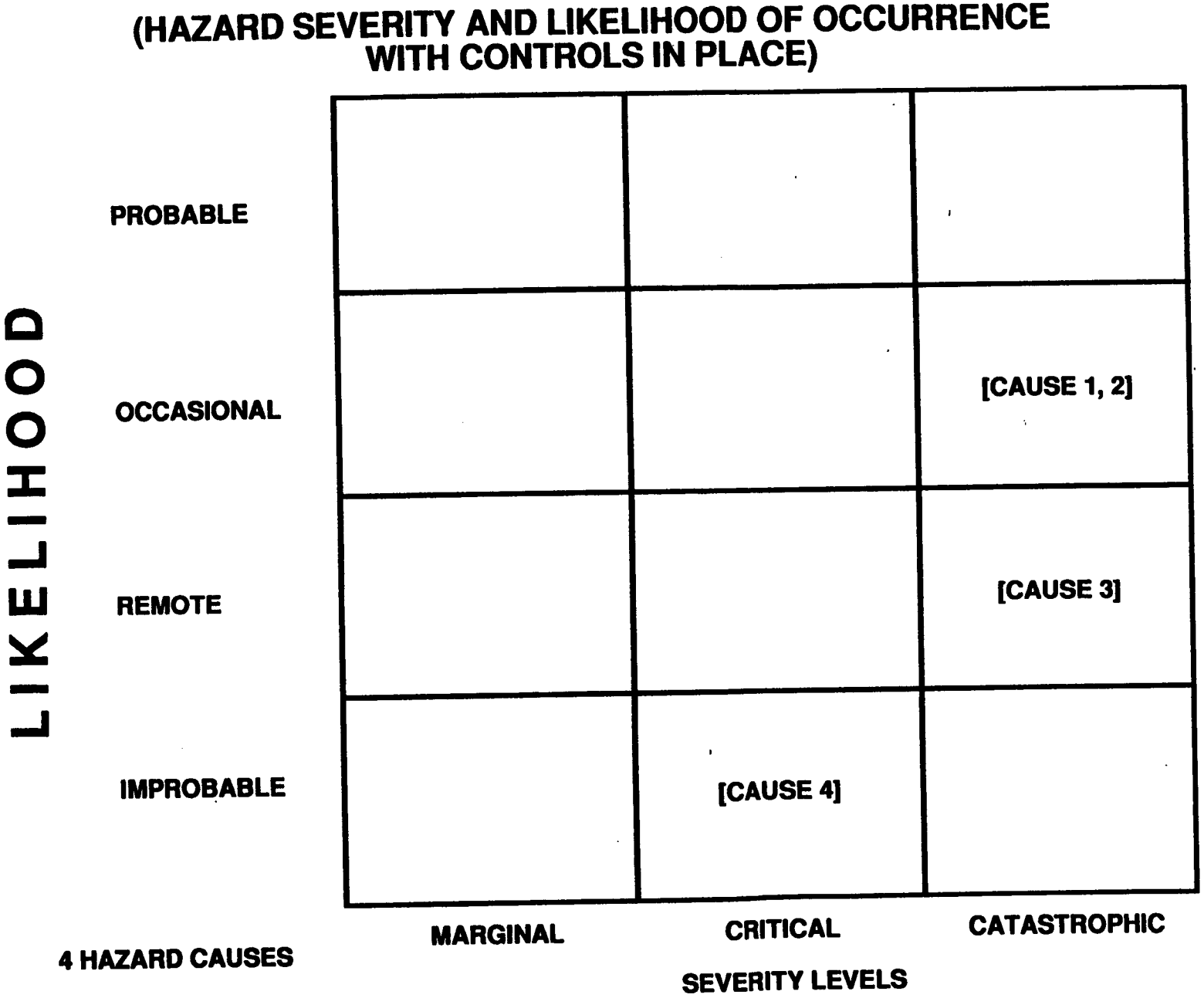


Figure G-1. Risk Picture (Example)

APPENDIX H

ANALYSIS TECHNIQUES

The purpose of safety analyses is to provide a means to systematically and objectively identify hazards, determine their risk level, and provide the mechanism for their elimination or control. It is an iterative process that begins in the Concept Phase and extends throughout the life cycle including the Disposal Phase.

1. Functions supported by the analysis include:

   a. Providing the foundation for the development of safety criteria and requirements.

   b. Determining whether and how the safety criteria and requirements provided to engineering have been included in the design.

   c. Determining whether the safety criteria and requirements created for design and operations have provided an acceptable level of risk for the system.

   d. Providing part of the means for imposing pre-established safety goals.

   e. Providing a means for demonstrating that safety goals have been met.

The extent and depth of analysis required to meet these five functions will be determined by system complexity and loss potential.

2. During the hazard identification process, it is essential to remain non-judgmental about the associated probabilities, severities, and corrective actions. Once identified, hazards shall then be ranked by severity, probability of occurrence, and program impact (risk assessment). Sufficient analyses must be performed to assess the likelihood of occurrence (usually qualitative for early assessments) for each identified undesired event.

3. There are several types of analyses necessary to identify all the hazards, some of which are specialized and others which, as designs mature, build on previously accomplished analyses.

4. Analyses such as the ones described below shall be employed to the extent and depth determined by the SSM as necessary to fully assess the risk to personnel, equipment, and property:

   a. Preliminary Hazard Analysis (PHA). In many ways the PHA is the most important of the safety analyses because it is the foundation on which the rest of the safety analyses and the system safety task are built. It

documents which generic hazards (see Figure H-1 for a sample checklist of generic hazards) are associated with the design and operational concept. This provides the initial framework for a master listing (or hazard catalog) of hazards and associated risks that require tracking and resolution during the course of the program design and development. The PHA also may be used to identify safety-critical systems that will require the application of Failure Modes and Effects Analysis and further hazard analysis during the design phases. The program shall require and document a PHA to obtain an initial listing of risk factors for a system concept. The PHA effort shall be started during the concept exploration phase or earliest life cycle phases of the program. A PHA considers hardware, software, and the operational concepts. Hazards identified in the PHA will be assessed for risk based on the best available data, including mishap data from similar systems, other lessons learned, and hazards associated with the proposed design or function. Mishap and lessons learned information are available in the Mishap Reporting and Corrective Action System (MR/CAS) and the Lessons Learned Information System (LLIS). The risk assessment developed from the PHA will be used to ensure safety considerations are included in tradeoff studies of design alternatives; development of safety requirements for program and design specifications, including software for safety-critical monitor and control; and definition of operational conditions and constraints.

b. Subsystem Hazard Analysis (SSHA) and System Hazard Analysis (SHA). These are extensions and refinements of the PHA that should coincide with the development of the design after the conceptual phase. A system generally consists of several discrete subsystems that should be individually analyzed (SSHA). The results of the SSHA's in turn feed into the SHA, which will integrate its subsystems and identify hazards that cross the subsystem interfaces. The number of systems and subsystems in a program is a function of the complexity of individual projects and will be determined by the program. In relatively simple programs, the SHA may also serve as the Integrated Hazard Analysis (IHA) if it also addresses use risks. The hazard listing in the Safety Assessment Report (SAR) must be updated to indicate the closure of hazards and newly identified hazards. The SHA should be completed coincidentally with the Critical Design Review (CDR).

GENERIC HAZARD	GENERIC HAZARD TYPE
I. CONTAMINATION/CORROSION	A. CHEMICAL DISASSOCIATION B. CHEMICAL REPLACEMENT/COMBINATION C. MOISTURE D. OXIDATION E. ORGANIC (FUNGUS/BACTERIAL, ETC.) F. PARTICULATE G. INORGANIC (INCLUDES ASBESTOS)
II. ELECTRICAL DISCHARGE/SHOCK	A. EXTERNAL SHOCK B. INTERNAL SHOCK C. STATIC DISCHARGE D. CORONA E. SHORT
III. ENVIRONMENTAL/WEATHER	A. FOG B. LIGHTNING C. PRECIPITATION (FOG/RAIN/SNOW/SLEET/HAIL) D. SAND/DUST E. VACUUM F. WIND G. TEMPERATURE EXTREMES
IV. FIRE/EXPLOSION	A. CHEMICAL CHANGE (EXOTHERMIC/ENDOTHERMIC) B. FUEL AND OXIDIZER IN PRESENCE OF PRESSURE AND IGNITION SOURCE C. PRESSURE RELEASE/IMPLOSION D. HIGH HEAT SOURCE
V. IMPACT/COLLISION	A. ACCELERATION (INCLUDING GRAVITY) B. DETACHED EQUIPMENT C. MECHANICAL SHOCK/VIBRATION/ACOUSTICAL D. METEOROIDS/METEORITES E. MOVING/ROTATING EQUIPMENT
VI. LOSS OF HABITABLE ENVIRONMENT*	A. CONTAMINATION B. HIGH PRESSURE C. LOW OXYGEN CONTENT D. LOW PRESSURE E. TOXICITY F. LOW TEMPERATURE G. HIGH TEMPERATURE
VII. PATHOLOGICAL/PHYSIOLOGICAL/ PSYCHOLOGICAL*	A. ACCELERATION/SHOCK/IMPACT/VIBRATION B. ATMOSPHERIC PRESSURE (HIGH, LOW, RAPID CHANGE) C. HUMIDITY D. ILLNESS E. NOISE F. SHARP EDGES G. SLEEP, LACK OF H. VISIBILITY (GLARE, WINDOW/HELMET FOGGING) I. TEMPERATURE J. WORKLOAD, EXCESSIVE K. HIGH PLACES (POSSIBLE FALLING)
VIII. RADIATION*	A. ELECTROMAGNETIC B. IONIZING RADIATION (INCLUDES RADON) C. NONIONIZING RADIATION
IX. TEMPERATURE EXTREMES	A. HIGH B. LOW C. VARIATIONS

* Health issues require coordination with Occupational Health Personnel.

Figure H-1. Sample List of Generic Hazards

c. Operating and Support Hazard Analysis (O&SHA). The O&SHA is performed primarily to identify and evaluate the hazards associated with the use of environment, personnel interface, procedures including automated command and control, and supporting facilities/equipment involved in the operation of a system/element. "Operation" for the purposes of this appendix may include, but is not limited to, activities such as testing, installation, maintenance, transportation, contingency operations, and others.

This analysis considers the planned system configuration or state at each phase of activity, the facility interfaces, the planned environments (or their ranges), the supporting tools or other equipment specified for use, operational/task sequence, concurrent task effects and limitations, biotechnological factors, regulatory or specified personnel safety and health requirements, and the potential for unplanned events including hazards introduced by human errors (see paragraph f, Human Factor Engineering Analysis.) The O&SHA shall identify the safety requirements (i.e., constraints, limitations, conditions) to eliminate hazards or to reduce the associated risk to a level that is acceptable under either regulatory or specified criteria. An O&SHA is also used to validate design safety by verifying that the system will perform as expected if the operator correctly performs each step of approved procedures. The O&SHA should be updated when any system design or operational changes are included to ensure any needed hazard control changes.

d. Integrated Hazard Analysis. A complex program will require analysis of the widely divergent elements or system designs that must be assembled and operated together. The IHA ensures that hazards, along with their causes and controls, that cross element, system, or operational interfaces are identified, assessed, and resolved to an acceptable level. For purposes of the IHA, integration should be considered an element of a system. This analysis should start with an integrated PHA and progress in parallel with other system or element safety analyses. This analysis is broader in scope in that it looks at an entire program rather than a portion of it. The IHA process should act as a conduit to facilitate notification of affected systems or elements when a hazard, cause, or control crosses an interface.

e. Software Safety Analysis. A PHA identifies the safety-critical characteristics of a system. If the PHA identifies hazards that are functions assigned to a software control or inhibit of the system undergoing analysis, that software must undergo safety analysis. When a system software component has been identified as safety-critical, the software safety analysis process shall begin with the development of safety objectives. The software objectives shall be derived by examining the properties of each critical function and expressing them in terms of system responses and consequences. These objectives shall be unique to each safety-critical software component. Software safety analysis verifies that the software

contains no errors or deficiencies that could contribute to risks to people or property. Software safety analysis consists of four phases: requirements analysis, design analysis, code analysis, and testing. The safety analysis effort shall begin with the requirements analysis phase of software development. This will ensure that all safety-critical requirements are specified and designed into the final software product. This approach to software safety analysis will provide optimum software safety with the least impact to the cost and schedule of the software development effort. The analysis techniques must be structured to allow for revisions and updates as the system matures.

f. Human Factors Engineering Analysis. The Program Manager should apply human factors engineering analysis for human error avoidance during the development and acquisition of NASA systems, equipment, software, and facilities to achieve the effective integration of the human element into system performance. A human error avoidance effort shall be provided to develop or improve the crew-equipment/software interface; to achieve required effectiveness of human performance during system operation and maintenance; to make economical use of personnel resources, skills, and training; and to minimize the possibility of human-induced error. Two-fault tolerance is required for all human errors that could result in a catastrophic hazard. The human error avoidance assessment shall be an integral part of the PHA, SHA, SSHA, and O&SHA, as required. Human engineering principles shall be applied to the design to eliminate or mitigate potential hazards associated with the man-machine interface. Extensions or transformations of the results of system safety efforts for use in the human error avoidance task are not considered duplication. Guidelines for the performance of a human error avoidance effort are found in NSS 17XX.XX, "Human Engineering Guidelines for Safety Assurance." Specific review of the operational hazard analysis by human factors engineers is required to ensure application of acceptable human factors criteria.

5. The following tools and techniques shall be selected as appropriate to help identify the primary causes of an identified hazard:

a. Failure Modes and Effects Analysis (FMEA). The FMEA is usually performed by the assigned Reliability office to identify critical items in hardware. The FMEA should be used to assist safety personnel to perform hazard analyses and supplement, not replace, hazard analyses. Safety personnel can use the FMEA to help verify that all safety-critical hardware has been addressed in the hazard analyses. The FMEA in hardware systems is an important technique for evaluating the design and documenting the review process. All credible failure modes and their resultant effects at the component and system levels are identified and

documented. The analysis follows a well-defined sequence of steps that encompasses (1) failure mode, (2) failure effects, (3) causes, (4) detectability, (5) corrective or preventative actions, and (6) rationale for acceptance.

b. Fault Tree Analysis (FTA). The FTA is a technique by which the system safety engineer can rigorously evaluate specific hazardous events. It is a type of logic tree that is developed by deductive logic from a top undesired event to all subevents that must occur to cause it. It is primarily used as a qualitative technique for studying hazardous event in systems, subsystems, components, or operations involving command paths. The FTA can be used to verify that the FMEA has identified all Critical Single Failure Points (CSFP's). It also can be used for quantitatively evaluating the probability of the top event and all subevent occurrences when sufficient and accurate data are available. Quantitative analyses shall be performed only when it is reasonably certain that the data for part/component failures and human errors for the operational environment exist. Cut sets shall be performed to establish fault tolerances.

c. Sneak Circuit Analysis (SCA). The SCA is a technique by which the system safety engineer can identify latent conditions (e.g., electrical, hydraulic, or other control systems) not caused by component failure that can inhibit desired functions or cause undesired functions to occur. A full-scale SCA may not be feasible depending on project constraints. Therefore, an SCA can be done on catastrophic hazards as identified by system-level FMEA or hazards analyses.

d. Event Tree Analysis (ETA). The ETA is a technique by which the system safety engineer can evaluate possible outcomes using a type of logic tree. It is an inductive logic method for identifying the various possible outcomes of a given initiating event.

APPENDIX I

HAZARDOUS OPERATING PROCEDURE *

Each Installation shall identify hazardous operations and identify, assess, analyze, and develop adequate safety or health controls. Generally, all hazardous operations shall require Hazardous Operating Procedures (HOP's) or a Hazardous Operating Permit. HOP's consist of a detailed plan listing step-by-step functions or tasks to be performed on a system or equipment to ensure safe and efficient operations. The Hazardous Operating Permit lists special precautions, start and stop time of the operation, and the approving supervisor(s). Certain operations (e.g., rigging, high voltage, etc.) depend on adherence to overall standards and general guidelines as opposed to HOP's for each specific operation. In these cases, specific personnel certification requirements must be established as listed in Chapter 4. Personnel other than the certified operators shall be excluded from exposure to the operation.

1. Field Installations should document those hazardous operations for which personnel certification is a substitute for HOP's. Where risk dictates, personnel will work in pairs (buddy system). There will be cases where both HOP's and certification will be necessary, and none of the above precludes dual controls.

2. HOP's should be written to provide maximum protection to personnel, prevent procedural error, and minimize misinterpretation. Specific steps in which a malfunction or error produces a reaction that causes system degradation, personnel injury, or death shall be preceded by one of the following precautionary notes:

> **WARNING**
>
> Maintenance or operating procedures, techniques, restrictions, etc., may result in severe personnel injury, loss of life, or major equipment damage if not followed exactly.

> **CAUTION**
>
> Maintenance or operating procedures, techniques, restrictions, etc., may result in some damage to equipment or system or minor injuries to personnel if not followed exactly.

* Joint Safety and Health responsibility.

NOTE
Maintenance or operating procedures, techniques, restrictions, etc., require emphasis for safe operation.

3. HOP's shall include steps to:

   a. Ensure the safety and health of personnel.

   b. Specify actions to bring the emergency situation under control.

   c. Return the system(s) to nearest possible safe condition.

4. Hazardous procedures shall be conspicuously marked hazardous on the title page to alert operators that strict adherence to the procedural steps and safety and health precautions contained therein is required to assure safety and health of personnel and equipment.

5. All HOP's shall have an approval signature to certify that a review has been performed by the cognizant NASA/contractor safety or health representative(s). Deviation or changes to the procedures also require the approval of the cognizant NASA/contractor safety offices. Procedures to develop Field Installation HOP's will include the requirement that line management concurs with the proposed HOP.

NOTE: The use of the specific nomenclature "HOP's" is not required. Local nomenclature that denotes safety- or health-critical procedures is acceptable.

APPENDIX J

TYPICAL FACILITY MILESTONE TASKS

At each phase in the facility life cycle, specific safety tasks shall be accomplished to ensure safety during construction, operation, and maintenance of the facility, and final disposition. Safety tasks included in each phase are discussed below. The Safety Management Plan (SMP) for each facility acquisition should be tailored to include those tasks appropriate considering the size and complexity of the project and the associated safety risks. Figure J-1, "Facility Safety Program Phases," illustrates representative tasks for a facility acquisition project. The recognized NASA facility life cycle consists of the following eight phases:

1. Functional Requirements and Concept Development. The Field Installation Safety Office participation must begin with this phase. The Safety Office is required to evaluate the alternative concepts under consideration and establish system safety programs consistent with the identified functional requirement. System safety tasks applicable to the functional requirement and facility concept development phase shall be identified. System safety tasks should include the following:

    a. Prepare a facility safety management plan to describe the proposed integrated system safety effort for the design, procurement, construction, acceptance, and operation of the facility.

* b. Evaluate all considered materials, design features, maintenance, servicing, operational concepts, and environments that will affect safety. Consider hazards that may be encountered in the ultimate disposition of the entire facility, its components, or dedicated support equipment. Particular concerns relate to the disposition of hazardous materials and substances.

    c. Identify possible safety interface problems, including those associated with software-controlled system functions.

    d. Review safe and successful designs of similar systems for consideration in alternative concepts.

    e. Obtain and apply the appropriate system safety lessons learned from historical files of safety, occupational health, human factors, and other discipline's experiences with similar facilities and operations.

    f. Identify safety requirements that may require a waiver during the system life cycle.

* Health-related concerns such as noise, radiation, toxic materials, etc., will be coordinated with the Occupational Health Office.

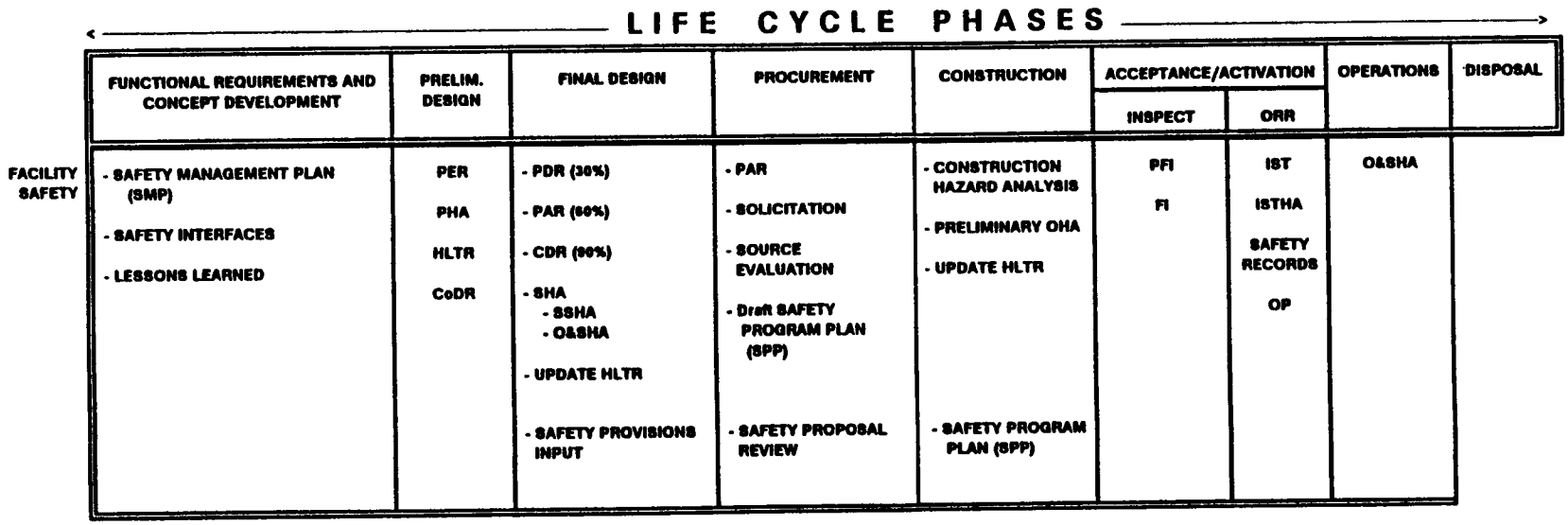


Figure J-1. Facility Safety Program Phases

2. Preliminary Design. Safety tasks applicable to the preliminary design phase support the development of the Preliminary Engineering Report (PER) that is described in detail in NHB 8820.2, "Facility Project Implementation Handbook." Safety tasks to support the PER shall include the following:

a. Update the SMP to describe the proposed integrated safety effort for the project.

b. Participate in tradeoff studies to determine the impact on system safety requirements and risk. Recommend facility design changes based on these studies to ensure the optimum degree of safety is achieved consistent with functional requirements.

c. Establish safety requirements for facility design and criteria for verifying that these requirements have been met. Identify the requirements for inclusion in the appropriate specifications, including potential work by subcontractors.

d. Perform a Preliminary Hazard Analysis (PHA) to identify safety-critical areas, evaluate hazards, and identify safety design criteria. The PHA begins during earliest life cycle phases. Then, based on the best available data, including mishap and lessons learned information (available in the Mishap Reporting and Corrective Action System and the Lessons Learned Information System), the PHA evaluates hazards associated with the proposed design or function. The PHA shall consider the following for identification and evaluation of hazards:

(1) Hazardous components (e.g., fuels, propellants, explosives, hazardous construction materials, pressure systems, and other energy sources).

(2) Safety-related interface considerations among various elements of the system (e.g., material compatibilities, electromagnetic interference, inadvertent activation, fire/explosive initiation and propagation, and hardware and software controls).

* (3) Environmental constraints including the operating environments (e.g., drop, shock, vibration, extreme temperatures, noise, exposure to toxic substances, health hazards, fire, electrostatic discharge, lightning, electromagnetic environmental effects, ionizing and non-ionizing radiation including laser radiation).

* Requires coordination with Occupational Health.

(4) Operating, test, maintenance, and emergency procedures (e.g., human factors engineering, human error analysis of operator functions, tasks, and requirements; effect of factors such as equipment layout, lighting requirements, and potential exposures to effects of noise or radiation on human performance; life support requirements and their safety implications in manned systems, crash safety, egress, rescue, survival, and salvage).

* (5) Facilities, support equipment (e.g., provisions for storage, assembly, checkout, and prooftesting of hazardous system/assemblies that may include toxic, flammable, explosive, corrosive or cryogenic fluids; radiation or noise emitters; or electrical power sources) and training (e.g., training and certification pertaining to safety operations and maintenance).

* (6) Safety-related equipment, safeguards, and possible alternate approaches (e.g., interlocks, system redundancy, hardware or software fail safe design considerations, subsystem protection, fire suppression systems, personal protective equipment, industrial ventilation, and noise or radiation barriers).

e. Maintain a Hazard List Tracking Record (HLTR) or equivalent using the PHA as a starting point to record hazards and their resolution. The status of items in the HLTR shall be a formal agenda item at each life cycle review until resolved. The HLTR shall document:

(1) Hazard list describing each credible hazard, the risks, program impact, and the risk assessment.

(2) Known controls for the identified hazards.

(3) Verification of the hazard control implementation actions.

(4) Acceptance of the residual hazards indicated by appropriate management signature.

f. Participate in the Concept Design Review (CoDR).

3. Final (Intermediate) Design. During the final design phase, the PER is refined for inclusion in the solicitation package. Safety tasks shall include the following:

a. Update as applicable the Safety Program Plan (SPP) and continue effective and timely implementation during facility final design phase.

* Requires coordination with Occupational Health.

b. Perform safety hazard analyses (see Appendix H), e.g., subsystem hazard analyses, operating and support hazard analyses, and safety studies concurrent with the design/test effort to identify design and operating and support hazards. Recommend any required design changes and control procedures.

c. Participate in technical design and program reviews and present results of safety hazard analyses. Design reviews normally include the following:

(1) Preliminary Design Review (PDR) at the 30-percent design stage.

(2) Pre-Advertisement Review (PAR) commencing at the 60-percent design stage and continuing until final preparation of the contract solicitation documents.

(3) Critical Design Review (CDR) at the 90-percent design stage.

d. Review engineering designs for incorporation of safety design requirements and to ensure hazards identified during the earlier phases are eliminated or the associated risks reduced to an acceptable level.

e. Update system safety requirements in system specification/design documents.

f. Evaluate results of safety testing, other system tests, failure analyses, and mishap investigations. Recommend redesign or other corrective action.

* g. Verify the adequacy of proposed safety and warning devices, life support equipment, and personal protective equipment.

h. Review system operation and maintenance publications for adequate safety considerations, and ensure the inclusion of applicable Occupational Safety and Health Administration (OSHA) requirements.

i. Ensure compliance with all applicable building safety codes, in accordance with PL 100-678, "Public Buildings Amendments of 1988."

j. Update the HLTR.

* Requires coordination with Occupational Health.

4. Procurement. Safety tasks during the procurement phase ensure that potential bidders clearly understand the safety requirements and evaluate bids for compliance with those requirements. Safety tasks shall include the following:

a. Participate in the PAR starting at the 60 percent design review and continuing until the preparation of the contract solicitation documents. Safety personnel shall participate in tailoring Section 01061, "General Safety Requirements," of NASA SPECSINTACT for each facility procurement to ensure that the appropriate safety tasks are specified in the contract documents as follows:

(1) Require the general contractor or construction contractor to designate a safety point of contact for the performance of each contract. The contractor shall monitor and enforce compliance with NASA-approved safety provisions by all contractor, subcontractor, and supplier organizations.

(2) Require a proposed (draft) construction SPP meeting the requirements of Chapter 2 and Appendix E of this document.

(3) Require all contractor and subcontractor safety management, employees, and workers who engage in specific occupations or construction skills requiring licensing or certification to provide a current record of these to the Contracting Officer and to maintain such licensing or certification.

b. Participate in potential bidder on-site visits and pre-bid conferences to ensure that special working site safety conditions and system safety provisions are understood.

c. Submit safety input to the Source Evaluation Board if applicable to the contract.

(1) Review adequacy of contractors' proposed construction SPP that shall contain the following as a minimum:

(a) A qualified manager.

(b) A representative organization.

(c) A clear responsibility assignment and authority delegations.

(d) Adequate resources.

(2) Provide safety-related information on bidders from prior NASA contract performance such as accident history, adequacy of contractor SPP, and performance of contractor safety organization.

5. Construction (Manufacturing). Safety tasks during the construction phase focus on construction worksite safety, ensuring hazard controls are properly installed, and identifying hazards at interfaces and resulting from change orders. Safety tasks shall include the following:

a. Participate in the Pre-Construction Conference to ensure the contractor's construction SPP is appropriately developed. Construction shall not proceed until the contractor's SPP is approved by the Contracting Officer in coordination with the Field Installation Safety Office.

b. Ensure compliance with all applicable building safety codes, in accordance with PL 100-678. The U.S. Army Corps of Engineers, Safety and Health Requirements Manual (EM 385 1-1) also is an approved reference document to be followed as applicable.

c. Conduct hazard analyses to determine safety requirements at all interfaces between the facility and those systems planned for installation.

d. Review equipment installation, operation, and maintenance plans to ensure all design and procedural safety requirements have been met.

e. Evaluate mishaps or other losses to determine that adequate corrective action is implemented.

f. Update hazard analyses to identify potential safety hazards from change orders.

g. Conduct construction or fabrication surveillance of construction worksite safety, safety program compliance reviews, and scheduled review and approval of contract deliverables.

h. Update the HTLR.

6. (Test, Validation and) Acceptance/Activation

a. General. Inspection and acceptance shall be scheduled when facilities constructed for Field Installations have been completed as described in the contract documents and the facility can be activated or can accommodate the intended function. Facility safety is an integral part of the acceptance phase.

b. Inspection and Acceptance Responsibilities

(1) Pre-Final Inspection (PFI). When work is substantially complete, arrangements shall be made to inspect the facility before the scheduled final completion date. The facility project manager (FPM), the assigned inspector, the contractor, and safety personnel

shall conduct the PFI. This inspection identifies defects and deficiencies and schedules the necessary corrective work. Safety personnel shall verify that the specified safety features are provided in accordance with the contract drawings and specifications and should:

(a) Identify and highlight those safety deficiencies that could delay installation of critical mission equipment.

(b) Identify instances where safety deficiencies would impose undue additional expense.

The contractor will normally develop a schedule for the work to correct these deficiencies and, after approval, will provide a copy of the schedule to the FPM. The contractor will correct these items and with the FPM, the assigned inspector, and safety personnel, re-inspect the facility. It may be necessary to repeat the inspection several times. When the FPM and safety personnel are satisfied that the deficiencies have been corrected or controlled, the final inspection can be scheduled.

(2) Final Inspection (FI). The contracting officer or FPM shall establish the date for the FI. The number of inspection team members should be held to the minimum, but shall include safety personnel. The inspection generally includes:

(a) A tour of the entire facility project.

(b) Verification of the correction or control of previously identified safety deficiencies.

(c) Inspection of contractor products and operations (including installed equipment) for safety compliance. Safety-related controls must be demonstrated to be in working order.

(d) Provision for identifying those systems where the safety inspection will be made at a future date, e.g., those requiring suitable weather conditions for proper testing.

(e) Identification of any new safety deficiencies.

(3) Acceptance of Facilities

(a) The final report shall determine and provide the status of each major system or subsystem of the project. This will include a schedule of all safety inspections of equipment not inspected due to lack of actual operating conditions. A

schedule for the correction or control of any remaining deficiencies also will be provided.

(b) Proceedings for completion and acceptance of facility project work shall be in accordance with Chapter 6 of NHB 8820.2.

(c) The type of acceptance, i.e., full or limited, will depend upon the circumstances at the time that NASA assumes custody of the facility. A full discussion of types of acceptance and instructions on the uniform procedures for physical accountability, recording, and reporting of real property is provided in NHB 8800.15, "Real Estate Management Program Implementation Handbook."

c. Operational Readiness Review (ORR)

(1) Initial System Test (IST). Complex facilities with multiple interfaces, potential unidentified residual hazards, high energy sources, and a variety of controls and interlocks may require an IST before the ORR. This test will verify that all hazards have been identified and either removed or controlled, that the subsystems operate correctly, and that subsystem interfaces have been properly designed and constructed. Before initiating the IST, an IST Hazard Analysis (ISTHA) shall be conducted to identify hazards created during testing and the controls devised to eliminate or reduce those hazards to an acceptable level. These controls shall be incorporated in the IST plan and procedures that shall be approved by the Field Installation Safety Office. Any deviations to this plan or the procedures also shall be approved by the Field Installation Safety Office. Examples of facilities that are candidates for an IST are:

(a) Test stands.

(b) Launch complexes.

(c) Antennas.

(d) Wind tunnels.

(e) Other unique facilities.

(2) For facilities with a significant degree of risk of accident or improper operation that might cause personnel injury or death or serious damage to equipment, buildings, or adjoining areas, or where an IST has been performed, an ORR committee will be convened. The ORR committee, to include safety personnel, shall review hazards and controls, review the IST results if applicable,

verify an initially safe operation, and make recommendations to the Field Installation Director for final decision and approval concerning status of residual hazards and any restrictions or limitations on the operation of the facility.

(3) For less hazardous operations, an ORR team or a safety review team composed of construction inspectors, safety personnel, and others as appropriate shall perform an informal ORR. This team shall review hazards and controls, verify an initially safe operation, and make recommendations to the Facility Manager for final decision and approval concerning status of residual hazards and any restrictions or limitation on the operation of the facility.

(4) The Field Installation SR&QA Director shall determine the level of review (ORR committee or ORR team) to be conducted on facilities, equipment, operations, or processes.

7. Operations. The design of each facility includes the desired or the implicit life expectancy. Repair, maintenance, and rehabilitation are routine events during the life of a facility. An annual facility inspection shall be conducted and documented. As required, a formal Operating and Support Hazard Analysis (O&SHA) shall be performed. Significant hazards identified shall be eliminated or reduced to acceptable risk levels. Record of inspections and O&SHAs shall be retained on file at the involved installation for a minimum of 4 years.

8. * Disposal. In the disposal phase of the life cycle of a NASA facility, the potential safety and environmental aspects shall be evaluated. When required, a formal hazard or environmental analysis shall be prepared. The results of the analysis and courses of action to abate a hazardous situation shall be an integral part of the facility disposal plan. Safety/environmental personnel shall monitor hazardous conditions to ensure compliance with applicable laws and regulations.

* Occupational Health issues require coordination with Occupational Health personnel.

APPENDIX K

NASA MISHAP REPORT FORM 1627 INSTRUCTIONS

This appendix will provide guidance to supervisors in filling out the NASA Mishap Report Form, NF 1627, and also will assist operators of the Mishap Reporting and Corrective Action System (MR/CAS) automated database in their input and update of mishap information. Additional guidance may be found in the training video, "NASA Safety/Form 1627," available at each facility's Safety Office or training center and the NASA Safety and Risk Management Division at Headquarters.

Form 1627 must be filled out by a supervisor. It is an NCR form with instructions and codes on the reverse sides. The unshaded areas on the white sheet constitute the Initial Report (Figures K-1 and K-2), which must be submitted to the appropriate Field Installation Safety Office within 1 working day of the mishap. The remaining areas on the yellow sheet constitute the Followup Report (Figures K-3 and K-4 in paragraph b), which must be submitted to the Safety Office at the completion of the investigation but no later than 10 working days after the mishap. The 10-day suspense period does not apply to any mishap requiring a Board of Investigation. In those cases, Form 1627 will be completed when the Board report is finalized. The blue (File) copy (Figure K-5) should be retained by the reporting organization. The Master File Number will be filled in by the Field Installation Safety Office.

1. Form 1627, Initial Report (Figures K-1 and K-2).

   a. General Information

      Item 1: Enter the full name of the organization or company making this report.

      Item 2: Enter the date the mishap occurred in MM/DD/YY format.

      Example: 01/03/89 for January 3, 1989.

      Item 3: Enter the time the mishap occurred, using a 24-hour clock.

      Example: 0730 for 7:30 AM, 1930 for 7:30 PM.

NASA

National Aeronautics and Space Administration

NASA Mishap Report

MASTER FILE NO.

NOTE: Fill in unshaded blocks within 24 hours. Please print or type. See reverse for instructions.

GENERAL INFORMATION

1. NAME OF ORGANIZATION | 2. MISHAP DATE (MDY) | 3. MISHAP TIME (24 hrs.) | 4. ORG FILE NO

5. MISHAP CATEGORY (Check as appropriate)

TYPE A	TYPE B	TYPE C	INCIDENT
1 _ DEATH	2 _ LOST TIME	2 _ LOST TIME	4 _ INJURY
2 _ LOST TIME	3 _ PERM. DISABILITY	4 _ INJURY	6 _ DAMAGE
4 _ INJURY	4 _ INJURY	6 _ DAMAGE	
6 _ DAMAGE	5 _ HOSPITALIZATION	7 _ TEST FAILURE	MISSION FAILURE
7 _ TEST FAILURE	6 _ DAMAGE		
	7 _ TEST FAILURE		

6. CLOSE CALL | 7. LEVEL OF POTENTIAL | 8. BLDG. NO. LOCATION

9. SPECIFIC AREA

10. MISSION AFFECTED | 11. PROGRAM IMPACT

12. DESCRIPTION OF MISHAP (Sequence of events, extent of damage and injuries, cause, if known, etc. Use additional sheets if necessary)

PERSONNEL INVOLVED

13. NAME (Last, first, middle initial) | 14. AGE | 15. SEX ☐ M ☐ F | 16. ORGANIZATION (CODE)/POSITION

17. SHIFT WORKED ☐ 1 ☐ 2 ☐ 3 | 18. HOURS OF CONTINUOUS DUTY BEFORE MISHAP | 19. FIRST AID ONLY ☐ YES ☐ NO | 20. FATALITY ☐ YES ☐ NO | 21. INJURY TYPE (Code)

22. BODY PART(S) AFFECTED (Codes) | 23. DAYS LOST NO. | ☐ TOTAL ☐ CONTINUING | 24. CAUSE(S) OF INJURY (Codes) PRIMARY | CONTRIB. | POTENTIAL AGENCY | 25. MISHAP ENVIRONMENT (Codes) ACTIVITY

26. HAS EMPLOYEE RECEIVED TRAINING/CERTIFICATION APPLICABLE TO TASK? ☐ YES ☐ NO

EQUIPMENT/PROPERTY DAMAGED

27. CLASS OF EQUIPMENT/PROPERTY DAMAGED
1 ☐ FLIGHT HARDWARE
2 ☐ GROUND SUPPORT EQUIPMENT (GSE)
3 ☐ FACILITY
4 ☐ PRESSURE VESSEL
5 ☐ MOTOR VEHICLE
6 ☐ AIRCRAFT
7 ☐ OTHER

28. SPECIFIC ITEM DAMAGED

29. SERIAL/NEMS NO. | 30. SYSTEM/SUBSYSTEM AFFECTED | 31. CAUSE(S) OF DAMAGE (Codes) PRIMARY | CONTRIB. | POTENTIAL | 32. COST ESTIMATE $ | FINAL $

33. SUBMITTED BY (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

CORRECTIVE ACTION

34. ACTION PLAN (Provide estimated completion date for each action. Use extra sheets if necessary)

35. APPROVED (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

36. NASA SAFETY CONCURRENCE WITH CORRECTIVE ACTION PLAN (Branch chief or higher)

CONCUR (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

NASA SAFETY OFFICE USE ONLY

37. LESSONS LEARNED ☐ YES ☐ NO | RISE NO. (If Yes)

40. APPROVAL FOR CLOSURE NAME AND TITLE | PHONE NO. | SIGNATURE | DATE

38. TYPE OF INVESTIGATION 1 ☐ BOARD 2 ☐ TEAM 3 ☐ INVESTIGATOR

39. STATUS ☐ OPEN ☐ CLOSED

NASA FORM 1627 MAY 89 PREVIOUS EDITION MAY BE USED. | RCS 10098000871

Figure K-1. NF 1627, NASA Mishap Report (Sheet 1, Initial Report)

INSTRUCTIONS

AS REQUIRED IN NMI 8621.IE, COMPLETE THE INITIAL MISHAP REPORT (WHITE COPY, UNSHADED PORTIONS) AND SUBMIT TO YOUR LOCAL NASA SAFETY OFFICE WITHIN 24 HOURS OF THE MISHAP OCCURRENCE. COMPLETE AND SUBMIT THE FOLLOW-UP REPORT (YELLOW COPY) WITHIN TEN WORKING DAYS OF THE MISHAP. RETAIN THE BLUE COPY FOR YOUR OWN FILES.

MASTER FILE NO. - DO NOT FILL IN. This number is assigned by the local NASA Safety Office.

GENERAL INFORMATION:

1. **NAME OF ORGANIZATION** - Enter complete name of organization which is reporting mishap.
2. **MISHAP DATE** - Enter date of mishap in MMDDYY format. Example: 060188.
3. **MISHAP TIME** - Enter time of mishap using 24-hour clock. Examples: 0930 for 9:30 AM; 1415 for 2:15 PM.
4. **ORGANIZATION FILE NO.** - Assign file number using your organization's unique four-character code, the mishap number (sequential) using four digits, and the fiscal year using two digits. Example: EGB1-0001-89.
5. **MISHAP CATEGORY** - Check as appropriate. Refer to NMI 8621.1E for definitions. NOTE: Only one mishap category may be selected. Multiple selections within a category are permissible.
6. **CLOSE CALL** - Check if appropriate. Refer to NMI 8621.1E for definition.
7. **LEVEL OF POTENTIAL** - Enter a code from Mishap Categories (item #5) to reflect the potential impact of the actual mishap or close call under differing conditions.
8. **BLDG. NO/LOCATION** - Enter the building number and/or location where the mishap occurred.
9. **SPECIFIC AREA** - Describe the exact location of the mishap. Example: Third floor, far west corridor.
10. **MISSION AFFECTED** - Enter the name or number of the mission, program, or project affected by the mishap. Examples: STS-32; Delta 181.
11. **PROGRAM IMPACT** - Describe the effect on the mission, program, or project in terms of delay or significant cost adjustment. Example: Two-week launch delay.
12. **DESCRIPTION OF MISHAP** - Describe the event including information about the extent of damage and/or injury, conditions that led to the mishap, and cause if known at this time. Specify location of facility where medical treatment was provided.

PERSONNEL INVOLVED (If more than one person was injured, attach a NASA Mishap Report (Form 1627) with only this section completed for each additional person.):

13. **NAME** - Self-explanatory.
14. **AGE** - Self-explanatory.
15. **SEX** - Self-explanatory.
16. **ORGANIZATION/POSITION** - Enter the organization identification code (four-character code) and position title. Example: EGB1/Technician.
17. **SHIFT WORKED** - Check as appropriate.
18. **HOURS OF CONTINUOUS DUTY BEFORE MISHAP** - Self-explanatory.
19. **FIRST AID ONLY** - Check "Yes" if only First Aid treatment was administered to the individual.
20. **FATALITY** - Check as appropriate.
21. **INJURY TYPE** - Enter code. (See reverse of yellow sheet for appropriate code.)
22. **BODY PART(S) AFFECTED** - Enter up to 3 codes. (See reverse of yellow sheet for appropriate codes.)
23. **NUMBER OF LOST DAYS** - Enter the number of days lost. Check either "Total" or "Continuing".
24. **CAUSE(S) OF INJURY** - Enter codes. (See reverse of yellow sheet for appropriate codes.)
25. **MISHAP ENVIRONMENT** - Enter up to 3 codes for Agency and Activity. (See reverse of yellow sheet for appropriate codes.)
26. **HAS EMPLOYEE RECEIVED TRAINING/CERTIFICATION APPLICABLE TO TASK?** - Check as appropriate. If "Yes" and name of training course or type of certification is known, reference this information in Item #12, "Description of Mishap."

EQUIPMENT/PROPERTY DAMAGED:

27. **CLASS OF EQUIPMENT/PROPERTY DAMAGED** - Check as applicable.
28. **SPECIFIC ITEM DAMAGED** - Provide description.
29. **SERIAL NO. AND NEMS** - (NEMS – NASA Equipment Management System – number is located on the NASA property tag affixed to each piece of NASA equipment.)
30. **SYSTEM/SUBSYSTEM AFFECTED** - Indicate engineering system and subsystem of class of equipment/property damaged as identified in Item #27. Example: If the class indicated in Item #27 is Flight Hardware, the system and subsystem could be "Orbiter/Avionics."
31. **CAUSE(S) OF DAMAGE** - Enter codes. (See reverse of yellow sheet for appropriate codes.)
32. **COST** - If initial estimate is not immediately known, enter the minimum damage cost for the mishap category selected in Item #5. (Refer to NMI 8621.1E for definitions of COSTS and MISHAPS.) Provide Final Cost in follow-up report. Example: If Mishap Category is C8, the minimum damage cost is $25,000.
33. **REPORT SUBMITTED BY** - Self-explanatory.

CORRECTIVE ACTION:

34. **ACTION PLAN** - List planned corrective actions, responsible organizations and estimated completion dates.
35. **CORRECTIVE ACTION PLAN APPROVED BY** - Signature of appropriate level of management in reporting organization.
36. **NASA SAFETY CONCURRENCE WITH CORRECTIVE ACTION PLAN** - Signature of NASA Safety Branch Chief or higher level.

37-40. To be completed by NASA Safety Office.

Figure K-2. NF 1627, NASA Mishap Report (Sheet 1, Initial Report — Back)

Item 4: Enter the organization's file number for this report. Use the organization's unique 2-, 3-, or 4-character code, a 4-digit number indicating sequence, and the last 2 digits of the fiscal year. (Note: Codes are under configuration management. Call the Installation Safety Office for new codes. Do not make up your own code.)

Example: Code AOCO for the Alpha Omega Company, 0002 for the second event of fiscal year 19...89. The file number would be AOCO-0002-89.

Item 5: Check off the mishap type using the definitions from NMI 8621.1 or NHB 1700.1. Pick only one mishap type, (e.g., Type A, B, or C, etc., controlled by the most serious aspect of the occurrence). There may be multiple circumstances within that type but only one mishap type may be selected. For example, a mishap where property damage exceeded $250,000 and a lost-time injury was sustained would be categorized as a Type B2,6.

Note: Selecting TYPE C2-LOST TIME suggests that an injury was sustained; therefore, C4-INJURY does not need to be checked.

Item 6: Check off, if appropriate, to indicate a close call. A close call is an event that had the potential to be a serious mishap.

Item 7: (1) Assess the events of the mishap; (2) Determine the maximum severity of loss under the same conditions; and (3) Enter a code from Mishap Categories (Item 5) that reflects the maximum loss that could have occurred. The category selected for Item 7 should be more serious than the category selected in Item 5. (If a more serious potential does not exist, leave blank.)

Example: A1

Item 8: Enter the building number or other description of the location of the mishap.

Item 9: Enter the specific site at the location.

Item 10: Enter the name of the mission affected, e.g., STS-32. (Leave blank if not applicable.)

Item 11: Enter the effect on the mission, program, or project in terms of delay or significant cost adjustments. (Leave blank if not applicable.)

Example: Two-week launch delay.

Item 12: Enter a brief description of the mishap. (Attach additional sheets with detailed information if necessary.)

b. Personnel Injured. If more than one person was injured, attach an additional NASA Mishap Report (Form 1627), with Item 4 and this section (Item 13 through and including Item 22) completed for each additional person. When the investigation is complete, fill in Form 1627, Item 23 through and including Item 26, for each individual injured in the mishap.

Item 13: Enter the name of the individual injured. (Last name, first and middle initial.)

Item 14: Enter the age of the individual injured.

Item 15: Check off the sex of the individual injured.

Item 16: Enter the organization identification code (2-, 3-, or 4-character code from Item 4) and position title.

Example: AOCO/Technician.

Item 17: Check off the shift the involved individual worked, either 1st, 2nd, or 3rd.

Note: The shift beginning at dawn or later in the morning will be considered the first shift. The shift ending after midnight will be considered the third shift.

Item 18: Enter the number of continuous hours the employee had been working before the mishap. (Round off to nearest whole number.)

Item 19: Check YES only if Item 5 mishap categories do not apply. Checking YES indicated that no treatment beyond first aid was required. (Using Form 1627 and the automated MR/CAS to record and track first aid cases is a local option.)

Item 20: Check either YES or NO to indicate if the individual was fatally injured. If YES, the mishap category in Item 5 must be A1.

Item 21: This item requires a code that is found on the back of the yellow sheet. Select the primary injury type code and enter it in this block.

Item 22: This item requires codes that are found on the back of the yellow sheet. Select the Body Parts Affected code and enter it in this block. Up to three items can be selected. (Note: Items 23-26 are filled in for the followup report on the yellow copy of Form 1627.)

c. Equipment/Property Damage. If more than one piece of equipment or property is damaged, attach an additional NASA Mishap Report (Form 1627) with Item 4 and this section (Items 27, 28, and 32) completed for each additional equipment/property item damaged. When the investigation is complete, fill in Form 1627, Items 29 through 32, for each equipment/property item damaged.

Item 27: Check off the class of equipment or property that has been damaged.

Item 28: Enter the specific description of the damaged item.

Item 32: Enter the estimated cost of the mishap. If the amount is not immediately known, use the minimum amount for the type of mishap (Type A Mishap: $1,000,000; Type B Mishap: $250,000; Type C Mishap: $25,000; Incident: $1,000). The actual or final cost is reported at the end of the investigation in the Followup Report.

Item 33: A supervisor must complete and sign this report. The Form 1627 Initial Report (unshaded area) is now complete and must be forwarded to the appropriate NASA Field Installation Safety Office.

2. Form 1627, Followup Report (Figures K-3 and K-4). Ten days after the mishap, a Followup Report is due at the NASA Safety Office. (This is the yellow copy.) The investigation should be completed by this time, and information to fill in the remaining portion of Form 1627 should be available.

a. Personnel Involved.

Item 23: Enter the number of days lost due to the mishap. The day of the mishap does not count. Also check off whether the number entered is the total time lost, or if the work loss is continuing. If continuing, the supervisor must contact the Safety Office to report the total number of work days lost at the time of the employee's return to duty.

Item 24: Enter the cause codes that are found on the back of the yellow sheet (Figure K-4). These causes reflect the findings of an investigator, team, or board.

Example: PRIMARY C3 CONTRIBUTING E1
POTENTIAL F2

Item 25: This item requires codes that are found on the back of the yellow sheet (see Figure K-4). For AGENCY, enter up to three agency codes. For ACTIVITY, enter up to three activity codes.

Example: AGENCY: C N S
ACTIVITY: F M N

Item 26: Check off YES or NO to indicate whether the employee has received training/certification applicable to the task.

b. Equipment/Property Damage.

Item 29: Enter the serial number of the equipment involved and the NASA Equipment Management System (NEMS) number.

Item 30: Enter the system and subsystem affected by the mishap.

NASA

National Aeronautics and Space Administration

NASA Mishap Report

MASTER FILE NO.

NOTE: Fill in unshaded blocks within 24 hours. Please print or type. See reverse for instructions.

GENERAL INFORMATION

1. NAME OF ORGANIZATION | 2. MISHAP DATE (MDY) | 3. MISHAP TIME (24 hrs) | 4. ORG FILE NO

5. MISHAP CATEGORY (Check as appropriate)

TYPE A	TYPE B	TYPE C	INCIDENT
1 ☐ DEATH	2 ☐ LOST TIME	2 ☐ LOST TIME	4 ☐ INJURY
2 ☐ LOST TIME	3 ☐ PERM. DISABILITY	4 ☐ INJURY	6 ☐ DAMAGE
4 ☐ INJURY	4 ☐ INJURY	6 ☐ DAMAGE	
6 ☐ DAMAGE	5 ☐ HOSPITALIZATION	7 ☐ TEST FAILURE	MISSION FAILURE
7 ☐ TEST FAILURE	6 ☐ DAMAGE		
	7 ☐ TEST FAILURE		

6. CLOSE CALL | 7. LEVEL OF POTENTIAL | 8. BLDG NO. LOCATION

9. SPECIFIC AREA

10. MISSION AFFECTED | 11. PROGRAM IMPACT

12. DESCRIPTION OF MISHAP (Sequence of events, extent of damage and injuries, cause, if known, etc. Use additional sheets if necessary)

PERSONNEL INVOLVED

13. NAME (Last, first, middle initial) | 14. AGE | 15. SEX ☐ M ☐ F | 16. ORGANIZATION/CONTRACTOR/POSITION

17. SHIFT WORKED ☐ 1 ☐ 2 ☐ 3 | 18. HOURS OF CONTINUOUS DUTY BEFORE MISHAP | 19. FIRST AID ONLY ☐ YES ☐ NO | 20. FATALITY ☐ YES ☐ NO | 21. INJURY TYPE (Codes)

22. BODY PART(S) AFFECTED (Codes) | 23. DAYS LOST NO. | ☐ TOTAL ☐ CONTINUING | 24. CAUSE(S) OF INJURY (Codes) PRIMARY | CONTRIB. | POTENTIAL | 25. MISHAP ENVIRONMENT (Codes) AGENCY | ACTIVITY

26. HAS EMPLOYEE RECEIVED TRAINING/CERTIFICATION APPLICABLE TO TASK? ☐ YES ☐ NO

EQUIPMENT/PROPERTY DAMAGED

27. CLASS OF EQUIPMENT/PROPERTY DAMAGED
1 ☐ FLIGHT HARDWARE
2 ☐ GROUND SUPPORT EQUIPMENT (GSE)
3 ☐ FACILITY
4 ☐ PRESSURE VESSEL
5 ☐ MOTOR VEHICLE
6 ☐ AIRCRAFT
7 ☐ OTHER

28. DESCRIPTION OF DAMAGED

29. SERIAL/NEMS NO. | 30. SYSTEM/SUBSYSTEM AFFECTED | 31. CAUSE(S) OF DAMAGE (Codes) PRIMARY | CONTRIB. | POTENTIAL | 32. COST ESTIMATE $ | FINAL $

33. SUBMITTED BY (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

FOLLOW-UP REPORT (YELLOW)

CORRECTIVE ACTION

34. ACTION PLAN (Provide estimated completion date for each action. Use extra sheets if necessary)

35. APPROVED (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

36. NASA SAFETY CONCURRENCE WITH CORRECTIVE ACTION PLAN (Branch chief or higher)

CONCUR (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

NASA SAFETY OFFICE USE ONLY

37. LESSONS LEARNED ☐ YES ☐ NO | RISE NO. (If Yes)

38. TYPE OF INVESTIGATION 1 ☐ BOARD 2 ☐ TEAM 3 ☐ INVESTIGATOR

39. STATUS ☐ OPEN ☐ CLOSED

40. APPROVAL FOR CLOSURE NAME AND TITLE | PHONE NO. | SIGNATURE | DATE

NASA FORM 1627 MAY 89 PREVIOUS EDITION MAY BE USED. | NCS 10000000871

Figure K-3. NF 1627, NASA Mishap Report (Sheet 2, Followup Report)

CODES

ITEM 21. **INJURY TYPE** - Enter one of the following codes to identify the category of injury:

(H0[illegible]	Abrasion	(H04)	Contusion, Bruise	(I09)	Internal Injuries
(C02)	Avulsion	(I03)	Dermatitis	(H06)	Laceration
(C01)	Amputation	(I96)	Multiple Injuries	(P00)	Pain
(H02)	Bites, Stings	(E06)	Electrical Shock	(J00)	Oxygen Deficiency
(H07)	Punctures	(I04)	Exhaustion	(Z68)	Shock, Trauma
(A00)	Burn, Chemical	(F07)	Fracture	(G03)	Strain, Sprain
(B00)	Burn, Thermal	(I06)	Hernia	(T06)	Toxicosis
(Z76)	Concussion	(I00)	Inhalation, Absorption, Ingestion	(Z98)	Other/Unknown
(G06)	Exposure				

ITEM 22. **BODY PART(S) AFFECTED** - Enter up to 3 of the following body part codes. (The first code entered should indicate Section of Body.):

Section of Body		Part of Body					
(A00)	Body in general	(D10)	Abdomen	(F35)	Foot	(B16)	Mouth/Teeth
(D00)	Torso (Chest)	(F21)	Ankle	(E22)	Forearm	(C05)	Neck
(B00)	Head/Facial	(E13)	Upper Arm	(D53)	Groin	(B06)	Nose
(E00)	Upper Extremities	(D30)	Back	(E30)	Hand	(E11)	Shoulder
(F00)	Lower Extremities	(F22)	Calf/Shin	(D43)	Heart	(D46)	Side/Rib(s)
		(B03)	Ear(s)	(F33)	Heel	(D32)	Spine
		(E12)	Elbow	(D54)	Hip	(F34)	Toe(s)
		(B12)	Eye(s)	(B14)	Jaw	(D33)	Vertebra(e)
		(B10)	Face	(F11)	Knee	(E21)	Wrist
		(E31)	Finger(s)	(F10)	Leg		

ITEMS 24 AND 31. **CAUSES OF INJURY AND/OR DAMAGE** - Select up to 3 of the following codes to identify the causes of injury and/or damage. (Refer to NMI 8621.1E for definitions of Primary, Contributing and Potential Causes.) NOTE: Primary Cause must be indicated.

(C) Communications
- (1) Paging Warning Inadequate
- (2) Problem Reporting/ Tracking Inadequate
- (3) Schedule Conflicts
- (4) Task Coordination/ Planning Inadequate
- (5) Task Supervision Inadequate
- (6) Test Team Briefing Inadequate

(E) Equipment Failure
- (1) Design Deficiency
- (2) Maintenance
- (3) Material Failure
- (4) Material Defects

(F) Fire/Explosion
- (1) Chemical Change
- (2) Fuel/Oxidizer Near Ignition Source
- (3) Pressure Release/Implosion
- (4) High Heat Source

(A) Handling
- (1) Design Deficiency
- (2) Deviation from Procedure

(O) Hazardous Operation
- (1) Arrangement
- (2) Improper Illumination
- (3) Improper Ventilation
- (4) Improper Clothing
- (5) Improper Guarding
- (6) Unsafe Equipment
- (7) Deviation from Procedure
- (8) Improper Protection

(H) Human Factors
- (1) Distraction
- (2) Fatigue
- (3) Safety Violation
- (4) Lack of Experience
- (5) Working Environment
- (6) Lack of Authority
- (7) Lack of Attention
- (9) Misjudgment of Conditions

(N) Natural Phenomenon
- (1) Lightning
- (2) Wind
- (3) Rain
- (4) Hail
- (5) Earthquake

(T) Organizational Deficiency
- (1) Lack of Training
- (2) Lack of Certification
- (3) Expired Certification

(P) Procedure
- (1) Requirements Inadequate
- (2) Procedure Deficiency
- (3) Technical Data Deficiency

(M) Toxic Material
- (1) Design Deficiency
- (2) Improper Handling

ITEM 25. **MISHAP ENVIRONMENT**

AGENCY - Enter up to 3 Agency codes:

- (A) Animals
- (B) Boilers/Pressure Vessels
- (C) Chemicals
- (D) Conveyors
- (E) Dust
- (F) Electrical Apparatus
- (G) Elevators
- (H) Hand Tools
- (I) Highly Flammable, Hot/ Toxic Substances
- (J) Hoisting Apparatus (Cranes, Winches, etc.)
- (K) Machines
- (L) Material
- (M) Mechanical Power Transmission Apparatus
- (N) Prime Movers and Pumps
- (O) Radiation/Radiating Substances
- (P) Vehicles
- (Q) Working/Walking Surfaces (Stairs, Platforms, etc.)
- (S) Temperature Extremes
- (T) Electrical Current
- (Z) Agency Not Elsewhere Classified

ACTIVITY - Enter up to 3 Activity codes:

- (A) Striking Against
- (B) Struck By
- (C) Caught in/On/Between
- (D) Fall on Same Level
- (E) Fall to Different Level
- (F) Slip (not fall)/Trip
- (M) Dropped, Spilled, Splashed
- (N) Lifting, Moving
- (P) Ascending/Descending
- (Q) Twisting/Turning
- (R) Over-Exertion
- (S) Pushing/Pulling
- (Z) Activity Not Elsewhere Classified

Figure K-4. Form 1627, NASA Mishap Report (Sheet 2, Followup Report — Back)

Example: If the class indicated in Item 27 is FLIGHT HARDWARE, the system/ subsystem could be REACTION CONTROL SYSTEM/HEATERS.

Item 31: This item requires codes that are found on the back of the yellow sheet (Figure K-4). The causes reflect the findings of an investigator, team, or board.

Example: PRIMARY C4 CONTRIBUTING E4 POTENTIAL 06.

Item 32: Enter the final cost of the mishap.

c. Corrective Actions.

Item 34: Enter the actions planned to correct the situation that caused the mishap and prevent the same or similar mishaps from recurring. Also enter the organization(s) responsible and the estimated completion date for each item in the plan. Attach additional sheets if necessary.

Item 35: The manager responsible for approving the Corrective Action Plan must sign here.

Item 36: The NASA Safety Official (Branch Chief or higher or designee) who concurred with the Corrective Action Plan must sign here.

Form 1627 (Followup Report) is now complete and must be forwarded to the appropriate NASA Field Installation Safety Office.

3. Form 1627, NASA Safety Office Section.

Item 37: Check if a Lessons Learned document has been prepared and distributed. If YES, include reference number, if known. If Lessons Learned are developed at a later date, enter reference number on Form 1627 at that time.

Item 38: Check the appropriate method of investigation.

Item 39: Status is closed only after Item 40 is complete.

Item 40: An official from the local NASA Safety Office must complete this section to indicate closure of the mishap file. Closure is appropriate upon completion of all action plan items.

NASA
National Aeronautics and Space Administration

NASA Mishap Report

MASTER FILE NO.

NOTE: Fill in unshaded blocks within 24 hours. Please print or type. See reverse for instructions.

GENERAL INFORMATION

1 NAME OF ORGANIZATION | 2 MISHAP DATE (MDY) | 3 MISHAP TIME (24 hrs) | 4 ORG FILE NO

5 MISHAP CATEGORY (Check as appropriate)

TYPE A	TYPE B	TYPE C	INCIDENT
1 _ DEATH	2 _ LOST TIME	2 _ LOST TIME	4 _ INJURY
2 _ LOST TIME	3 _ PERM. DISABILITY	4 _ INJURY	6 _ DAMAGE
4 _ INJURY	4 _ INJURY	6 _ DAMAGE	
6 _ DAMAGE	5 _ HOSPITALIZATION	7 _ TEST FAILURE	MISSION FAILURE
7 _ TEST FAILURE	6 _ DAMAGE		
	7 _ TEST FAILURE		

6 CLOSE CALL | 7 LEVEL OF POTENTIAL | 8 BLDG NO LOCATION

9 SPECIFIC AREA

10 MISSION AFFECTED | 11 PROGRAM IMPACT

12. DESCRIPTION OF MISHAP (Sequence of events, extent of damage and injuries, cause, if known, etc. Use additional sheets if necessary)

PERSONNEL INVOLVED

13. NAME (Last, first, middle initial) | 14. AGE | 15. SEX ☐ M ☐ F | 16. ORGANIZATION (CODE)/POSITION

17. SHIFT WORKED ☐ 1 ☐ 2 ☐ 3 | 18. HOURS OF CONTINUOUS DUTY BEFORE MISHAP | 19. FIRST AID ONLY ☐ YES ☐ NO | 20. FATALITY ☐ YES ☐ NO | 21. INJURY TYPE (Code)

22. BODY PART(S) AFFECTED (Codes) | 23. DAYS LOST: NO. | ☐ TOTAL ☐ CONTINUING | 24. CAUSE(S) OF INJURY (Codes): PRIMARY | CONTRIB. | POTENTIAL | 25. MISHAP ENVIRONMENT (Codes): AGENCY | ACTIVITY

26. HAS EMPLOYEE RECEIVED TRAINING/CERTIFICATION APPLICABLE TO TASK? ☐ YES ☐ NO

EQUIPMENT/PROPERTY DAMAGED

27. CLASS OF EQUIPMENT/PROPERTY DAMAGED

1 ☐ FLIGHT HARDWARE
2 ☐ GROUND SUPPORT EQUIPMENT (GSE)
3 ☐ FACILITY
4 ☐ PRESSURE VESSEL
5 ☐ MOTOR VEHICLE
6 ☐ AIRCRAFT
7 ☐ OTHER

28. SPECIFIC ITEM DAMAGED

29. SERIAL/NEMS NO. | 30. SYSTEM/SUBSYSTEM AFFECTED | 31. CAUSE(S) OF DAMAGE (Codes): PRIMARY | CONTRIB. | POTENTIAL | 32. COST: ESTIMATE $ | FINAL $

33. SUBMITTED BY (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

CORRECTIVE ACTION

34. ACTION PLAN (Provide estimated completion date for each action. Use extra sheets if necessary)

35. APPROVED (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

36. NASA SAFETY CONCURRENCE WITH CORRECTIVE ACTION PLAN (Branch chief or higher)

CONCUR (Name, title, mail code) | SIGNATURE | PHONE NO. | DATE

NASA SAFETY OFFICE USE ONLY

37. LESSONS LEARNED ☐ YES ☐ NO | RISK NO. (if Yes)

38. TYPE OF INVESTIGATION 1 ☐ BOARD 2 ☐ TEAM 3 ☐ INVESTIGATOR

39. STATUS ☐ OPEN ☐ CLOSED

40. APPROVAL FOR CLOSURE: NAME AND TITLE | PHONE NO. | SIGNATURE | DATE

NASA FORM 1627 MAY 89 PREVIOUS EDITION MAY BE USED.

RCS 10000000671

Figure K-5. NF 1627, NASA Mishap Report (Sheet 3, File Copy)

This page intentionally left blank.

APPENDIX L

PARTICIPANTS FOR BOARD APPOINTMENT CONFERENCE

The following participants, or designees, should be involved in the conference for Headquarters-appointed boards or their counterparts for Field Installation-appointed boards:

1. Appropriate Program or Institutional Associate Administrator.

2. Director of Field Installation where mishap occurred.

3. Associate Administrator for SMQ.

4. Director, Safety and Risk Management Division Division.

5. General Counsel.

6. Associate Administrator for Public Affairs.

7. Director(s) of Field Installation(s) from which potential board members may be drawn.

8. Director, Occupational Health Office, for cases having medical or environmental health implications. A flight surgeon will be included for mishaps involving potential of crew injury or the use of crew egress equipment.

9. Director, Aircraft Management Office, for cases involving NASA aircraft.

10. Director, Facilities Engineering Division, for cases involving facility construction mishaps or having Construction of Facilities implications.

11. Director, International Relations Division, if the mishap occurred outside the U.S.

NOTE: The Director, NASA Safety and Risk Management Division, will provide support to the appointing official in board appointment formalities. At the Field Installation level, this will generally be accomplished by the Safety Director or safety counterpart. A plan shall be developed at the appropriate level to implement this procedure.

This page intentionally left blank.

APPENDIX M

NASA GUIDELINES FOR ESTABLISHING A MISHAP INVESTIGATION BOARD

September 6, 1991

DRAFT APPOINTMENT LETTER

Subject: (Insert Project or other Appropriate Title) MISSION FAILURE (or MISHAP) INVESTIGATION BOARD

NOTE: When the board will actually conduct all or most of the investigation instead of reviewing an investigation conducted by others, the following is provided as a guide. Deletions, additions, and other modifications to this sample will undoubtedly have to be made, particularly in paragraph 3, to adapt it to the circumstances and requirements related to any given situation.

1. PURPOSE

This establishes the (insert title) Investigation Board and sets forth its responsibilities and membership.

2. ESTABLISHMENT

a. The (insert title) Investigation Board is hereby established in the public interest to gather information, analyze, and determine the facts as well as the actual or probable cause(s) of the (insert with appropriate identification of mishap) in terms of (1) Primary Cause, (2) Contributing Cause(s), and (3) Potential Causes(s) (pertinent observations may also be addressed) and to recommend preventive and other appropriate actions to preclude recurrence of a similar mishap.

b. The board is considered a "project-oriented, technical team" or a "management/operations working group."

NOTE: Use this provision only if membership includes one or more persons who are not full-time Federal Government employees, so as to preclude the applicability of the Federal Advisory Committee Act and the Office of Management and Budget (OMB) Circular A-63 to these Investigation Boards.

c. The chairperson of the board will report to the (appointing authority/designee).

3. AUTHORITIES AND RESPONSIBILITIES

a. The Board will:

(1) Obtain and analyze whatever evidence, facts, and opinions it considers relevant by relying upon reports of studies, findings, recommendations, and other actions by NASA officials and contractors or by conducting inquiries, hearings, tests, and other actions it deems appropriate. In so doing, it may take testimony and receive statements from witnesses.

(2) Impound property, equipment, and records to the extent that it considers necessary.

Note: Impoundment may not necessarily preclude release of information. General information which would normally be released or had been released previously can continue to be released.

(3) Determine the actual or probable cause(s) of the (insert project or other appropriate title) mission failure (or mishap), and document and prioritize their Findings in terms of (a) the Primary Causes(s) of the Mishap, (b) Contributing Causes(s), and (c) Potential Causes(s). Pertinent observations may also be made.

(4) Develop recommendations for preventive and other appropriate actions. A Finding may warrant one or more recommendations or it may stand alone.

(5) Provide a final written report to the (insert appointing authority). The requirements in NHB 1700.1 (V1-B) will be followed unless a waiver is obtained from the undersigned.

(6) Provide a proposed Lessons Learned Summary and a proposed Corrective Action Plan.

(7) Perform any other duties that may be requested by the (appointing authority/designee).

b. The Chairperson will:

(1) Conduct board activities in accordance with NHB 1700.1 (V1-B) and any other Instructions that the (appointing authority/designee) may issue.

(2) Establish and document, to the extent considered necessary, rules and procedures for the organization and operation of the board, including any subgroups, and for the format and content of oral or written reports to and by the board.

(3) Designate any representatives, consultants, experts, liaison officers, or other individuals who may be required to support the activities of the board and define the duties and responsibilities of those persons.

(4) Establish and announce a target date for submitting a final report and keep all concerned NASA officials informed of the board's plans, progress, and findings.

(5) Designate another member of the board to act as Chairperson in his/her absence.

4. MEMBERSHIP

The Chairperson, members of the board, and supporting staff are designated in Attachment A.

5. MEETINGS

The Chairperson will arrange for meetings and for such records or minutes of meetings as considered necessary.

6. ADMINISTRATIVE AND OTHER SUPPORT

a. The Director of (insert title of Field Installation) will arrange for office space and other facilities and services that may be requested by the chairperson or designee.

b. All elements of NASA will cooperate fully with the board and provide any records, data, and other administrative or technical support and services that may be requested.

c. A specific time (usually immediately) or milestone will be selected after which all activity physically affecting the hardware will cease, unless specifically directed by the board chairperson.

7. DURATION

The (appointing authority) will dismiss the board when it has fulfilled its requirements.

8. CANCELLATION

This appointment letter is automatically canceled 1 year from effective date of the publication, unless otherwise specifically extended by the establishing authority.

Signature Block

ATTACHMENT:

A. Members and Supporting Staff (insert title) Investigation Board.

ATTACHMENT A TO
APPOINTMENT LETTER

Members and Supporting Staff
(Insert Title) Investigation Board

MEMBERS

Chairperson: (Name)

Members: NOTE: The minimum possible number of members (including chairperson), usually five to nine, should be designated. A primary consideration will be the different types of skills and experience that will be required.

SUPPORTING STAFF

Advisors/nonvoting members:

Safety
Counsel
Public Affairs
Physician (If required)
Others (As Desired):

Others (as appropriate):

Life Sciences (Including Human Engineering)
Industrial Relations
International Relations (If outside U.S.)
Procurement
Reliability, Maintainability, and Quality Assurance
Occupational Health
Local Unions
Aircraft Management (for aircraft-related mishaps)
Facilities
Technical Writers
Others (as desired)

Observers: (Names)

NOTE: Consider the necessity and desirability for obtaining participation or assistance from employees of other groups within the Federal Government.

This page intentionally left blank.

APPENDIX N

MISHAP REPORTING AND CORRECTIVE ACTION SYSTEM AUTOMATED DATA BASE

This appendix will serve as a guide for Mishap Reporting and Corrective Action System (MR/CAS) operators in entering and updating information in the automated system. NASA safety personnel may also find this section useful in the implementation of the MR/CAS. Complete instructions for operating the MR/CAS may be found in the MR/CAS User's Guide.

Each Center must maintain its own MR/CAS data base on a computer that complies with the hardware/software specifications indicated in the MR/CAS Technical Manual. Inasmuch as the MR/CAS data base contains names of individuals involved in mishaps, measures must be taken to ensure that provisions of the Privacy Act are not violated. The MR/CAS software is provided by the NASA Safety and Risk Management Division. Data from each facility's MR/CAS data base must be electronically transmitted at the end of each month to a host data base at Headquarters. The MR/CAS operator must have the appropriate user accounts and access privileges in order to transmit the data.

Changes to the MR/CAS software are governed by the MR/CAS Configuration Control Board (CCB). Each facility must name a representative, preferably at the branch chief level, to the CCB.

NF 1627 is the data collection instrument for the MR/CAS. Safety personnel, including the MR/CAS operator, are responsible for reviewing the information on each form for accuracy and making corrections as needed before data are entered into the automated data base. Instructions for filling out Form 1627 may be found in Appendix K and should be used as guidance in reviewing each mishap report.

a. Entering Data. Upon informal or telephonic notification of a mishap, preliminary data may be entered into the data base. Change the default to "YES" after "Preliminary Report" and enter as much information as is available. Upon receipt of a Form 1627, and verification that a NASA Reportable Mishap has occurred, return the default to "NO" after "Preliminary Report." Enter the Initial Report information from a reviewed and corrected Form 1627.

(1) Fatalities Among Non-NASA/Contractor Groups. The MR/CAS data base at each facility must contain a complete record of each mishap with the exception of personal injuries to contractors at off-site facilities, construction contractors, military personnel, and visitors. Only fatalities occurring in these groups will be recorded in the automated data base using the organization code CC for construction contractors and ZZ for all others not permanently assigned to the NASA facility.

(2) Personnel Injured. The names of individuals who are injured in mishaps will be entered into the MR/CAS data base in the Personnel Record. The names of individuals who are witnesses to mishaps but are not injured will not be entered into the data base under any circumstances. The record of mishaps involving injuries to individuals who are on short-term TDY will be carried on the "home Center's" MR/CAS data base. However, the host Center will carry the record of any mishap involving injury to an individual on long-term TDY or detail.

(3) Incident with Injury Cases. It is a local option to use the MR/CAS to record contractor incident with injury cases on a case-by-case basis. As an alternative, the total number of cases will be entered monthly into the automated MR/CAS data base according to the instructions in the User's Manual.

(4) First Aid Cases. It is a local option to use Form 1627 and the MR/CAS to record cases where only first aid was administered. MR/CAS operators at Installations that choose to record these cases in the automated data base must ensure that no mishap type is entered in the record (item 5 on NF 1627). Change the default in the Personnel Record from "NO" to "YES" after "First Aid Only."

(5) Estimated Cost. The MR/CAS will automatically use the minimum cost for the mishap category selected. This amount must be changed to reflect an accurate estimate if one is provided on the mishap report.

b. Updating Data. Upon receipt and review of the Followup Report, the MR/CAS operator will enter all remaining information into the data base, including final cost for a mishap involving equipment/property damage. If there is no final cost for equipment/property damage, enter cause codes for all mishaps, and mishap environment codes for personal injury mishaps. (Mishap environment codes will be available on the equipment/property damage record in a later software release.)

c. Closing Mishap File. The mishap file may not be closed if the number of days lost is still continuing, or if the final cost or mishap causes have not been determined. Also, a mishap file may not be closed until the designated NASA safety official has signed the mishap report (NF 1627) to authorize closing the file.

d. Control Data. In addition to mishap information, the MR/CAS requires certain information to calculate lost time rates and to prepare several reports. This information must be entered monthly for each contractor organization and the NASA facility.

(1) Organization Codes. Each contractor organization must have a unique 2-, 3-, or 4-character code. For NASA, either a single code may be used, or each NASA organization within a facility may have a unique identifier. All codes are under configuration control and must be assigned upon request by the configuration manager. The NASA Safety and Risk Management Division may be contacted for the name and telephone number of the appropriate individual from whom to request organization codes. Under no circumstances will anyone other than the authorized individual assign organization codes. The MR/CAS operator should notify all organizations of their unique MR/CAS organization codes.

(2) Number of Personnel. The number of civil servants employed at the facility must be entered each month. These include full-time and part-time personnel in addition to interns and co-ops. It is a local option to enter the number of employees for contractor organizations.

(3) Number of Hours Worked. This information must be entered for civil servants and for each contractor organization. Hours worked refers to actual time on the job and will be calculated as follows:

(a) Base hours paid + overtime hours paid + compensation time earned - leave taken - compensation time taken = hours worked.

(b) Leave = annual leave, sick leave, holiday leave, jury duty, administrative leave, military leave, excused leave, suspended leave, religious leave, rest leave, graduate leave, and traumatic leave.

Do not enter hours worked for any contractor organization whose mishaps involving injuries to personnel are not recorded in the automated MR/CAS, i.e., off-site contractors.

(4) Miles driven/Hours Flown. It is a local action to record miles driven and hours flown in the MR/CAS.

e. Corrective Actions Tracking Module. The MR/CAS includes a module for recording and tracking corrective actions for each mishap. Use of this module is a local option. Data from this module are not transmitted to the host data base.

f. Lessons Learned. A Lessons Learned report may not always accompany the NF 1627 Followup Report but may be submitted at a later date. The MR/CAS data base must be updated to reflect that a Lessons Learned

report has been developed. Enter "Y" after Lessons Learned and the reference number from the Lessons Learned Information System.

g. Dropping Records. Entire mishap records or portions of records (personnel or equipment/property) may be dropped from the active data base at any time when deemed appropriate by safety management. These records may be retrieved and reincorporated into the active data base by entering the record number and selecting "Undrop" from the menu.

h. Transmitting Data. Mishap data and any control data in the system will be transmitted to the host data base at the NASA Safety and Risk Management Division on the last work day of each month. Field Installation Safety Offices have until the end of December to finalize their mishap data for the previous fiscal year. MR/CAS operators will transmit these final data to the host data base during the first full week of January. Any updates received after the January suspense date (to be announced each year by the NASA Safety and Risk Management Division) will not be included in the formal fiscal year NASA Safety Program Status Report.

i. Host Data base. The MR/CAS Host Data base is operated and maintained by the NASA Safety and Risk Management Division. After downloading and integrating the transmitted data, the host data base searches for and automatically deletes several types of data that are not used at the Headquarters level. These are First Aid Cases and Close Calls with level of potential of severity less than Type C and the names of individuals injured in mishaps.

j. Reports. Each quarter the NASA Safety and Risk Management Division prepares and distributes a quarterly safety program status report that is automatically produced by the MR/CAS Host Data base based on the data transmitted by the Field Installations. In addition, each fiscal year the NASA Safety and Risk Management Division publishes and distributes the NASA Safety Program Status Report, also based on the data transmitted by the Field Installations.

APPENDIX O

GLOSSARY OF SAFETY AND RISK MANAGEMENT TERMS

ACCEPTANCE TESTING — Tests to determine that a part, component, subsystem, or system is capable of meeting performance requirements over the environmental and operating ranges prescribed in the specification documents.

ACCEPTED RISK — A hazard whose risk is not completely mitigated and that has been accepted by top program and safety management.

ACCIDENT PREVENTION — Methods and procedures used to eliminate the causes which could lead to a mishap.

ACTION CENTERS — Emergency centers set up by the appropriate Installation official or program official to coordinate all communications, responses, and other actions for mishaps that have international, national, or regional implications; high visibility; or major public interest.

APPLIED LOAD (STRESS) — Actual load (stress) imposed on a system.

ARMING — Bringing a device or system to a state or condition that will allow its subsequent activation.

ASSESSMENT — Review or audit process, using predetermined methods, that evaluates hardware, software, procedures, technical and programmatic documents, and the adequacy of their implementation.

AUDIT — Formal review to assess compliance with hardware/software requirements, specifications, baselines, safety standards, procedures, instructions, codes, and contractual and licensing requirements.

AUTHORITY HAVING JURISDICTION (AHJ) — The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure. The AHJ for NASA fire protection will be designated in writing by the Field Installation Safety Director and shall be a safety or fire protection professional.

AVAILABILITY — Measure of the percentage of time that an item operates as intended.

BIOMECHANICS — Interdisciplinary science (comprising mainly anthropometry, mechanics, physiology, and engineering) of the mechanical structure and behavior of biological materials. It concerns primarily the dimensions and mass properties of body segments.

CATASTROPHIC — A hazard that could result in a mishap causing fatal injury to personnel, and/or loss of one or more major elements of the flight vehicle or ground facility.

CATASTROPHIC CONDITION — Hazardous condition that may cause death or major system destruction on the ground, or loss of crew or vehicle during the mission.

CATASTROPHIC FAILURE — Failure that causes loss of life or loss of a system or element thereof.

CERTIFICATION TEST — Test whose objective is to determine and then certify that system specifications are satisfied or personnel skills are present.

CERTIFIED PERSONNEL — Personnel who have completed required training and whose specified knowledge or proficiency in a skill has been demonstrated and documented.

CLOSE CALL — An occurrence in which there is no injury, no significant equipment/property damage (less than $1000), and no significant interruption of productive work, but which possesses a high severity potential for any of the mishaps as defined as Type A, B, C Mishap, Mission Failure, and Incident.

COLLATERAL INVESTIGATION — A line management investigation, formal or informal, whose objectives lie outside the scope of NMI 8621.1, e.g., to assign blame or guilt and recommend punitive actions.

CONFIGURATION ITEM — An item that is designated for configuration management.

CONTRACTOR SAFETY PLANS — Written plans prepared by the contractor detailing the overall safety program that will cover the employees, equipment, and facilities used to fulfill the contract.

CONTRIBUTING CAUSE — A factor, event, or circumstance which led, directly or indirectly, to the primary cause, or which contributed to the severity of the mishap.

CONTROLLED (RISK) HAZARD — The likelihood of occurrence or severity of the associated undesirable event has been reduced to an acceptable level through the imposition of appropriate, readily implementable, verifiable controls which results in minimal residual risk.

CORRECTIVE ACTION — Action taken to preclude continuation of a discrepancy or problem or recurrence of a mishap.

COSTS (MISHAP) — Direct costs of repair, retest, program delays, replacement, or recovery of NASA materials including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation (either by NASA, contractor, or consultant), injury, or normal operational shutdown. Materials or equipment replaced by another

organization at no cost to NASA will be calculated at "book" value. This includes those mishaps covered by insurance.

CREDIBLE CONDITION (EVENT) — Condition (event) that reasonably may be anticipated and planned for on the basis of experience with or analysis of a system.

CREW RATING — Certifying the incorporation of enhanced environmental support, reliability, and safety features into the design and operation of hardware and software essential for the preservation of life during crewed tests or operations.

CRITICAL LIFTING OPERATIONS — Lifting and lowering operations involving major programmatic or institutional hardware that is irreplaceable, or will cause serious program or mission delays if damaged, or is hazardous to personnel if dropped or uncontrolled, or will require special budgetary actions to repair damages suffered from lifting malfunctions.

CRITICAL SINGLE FAILURE POINT (CSFP) — A single item or element, essential to the safe functioning of a system or subsystem, whose failure in a life or mission-essential application would cause serious program or mission delays or be hazardous to personnel.

CRITICAL SOFTWARE COMMAND (CSC) — A command that either removes a safety inhibit or creates a hazardous condition.

DESIGN BURST PRESSURE — Pressure at which an element of a pressurized system would be expected to burst if it meets the exact design conditions.

DESIGN MARGIN — Percent by which a factor of safety of 1.0 is exceeded or deficient.

DEVIATION — A variance that authorizes departure from a particular safety requirement where the intent of the requirement is being met through alternate means that provide an equal or greater level of safety.

ELIMINATED HAZARD — A hazard that has been eliminated by completely removing the hazard causal factors.

EMERGENCY — Unintended circumstance bearing clear and present danger to personnel or property, which requires an immediate response.

EVENT TREE ANALYSIS (ETA) — An analysis that traces the effect of a mishap and leads to all possible consequences through visualization of the positive and negative sides for each event using a type of logic tree. Event trees are complements to fault trees. This is an inductive logic method for identifying the various possible outcomes of a given initiating event.

EXPOSURE — (1) Vulnerability of a population, property, or other value system to a given activity or hazard; or (2) other measure of the opportunity for failure or mishap events to occur.

FACTOR OF SAFETY (SAFETY FACTOR) — Ratio of the design condition to the maximum operating conditions specified during design. (See also Safety Margin and Margin of Safety.)

FAIL-OPERATIONAL — Ability to sustain a failure and retain full operational capability.

FAIL-SAFE — Ability to sustain a failure and retain the capability to safely terminate or control the operation.

FAILURE — Inability of a system, subsystem, component, or part to perform its required function within specified limits.

FAILURE ANALYSIS — A systematic examination of a failed item or system to identify the failure mode and cause.

FAILURE CAUSE — Physical or chemical process, design defect, quality defect, or other process that initiates a sequence of events leading to failure.

FAILURE EFFECT — Consequence of a failure mode on the operation, function, or status of an item or system.

FAILURE MODE — Particular way in which a failure can occur, independent of the reason for failure.

FAILURE MODES AND EFFECTS ANALYSIS (FMEA) — A bottoms up systematic, inductive, methodical analysis performed to identify and document all identifiable failure modes at a prescribed level and to specify the resultant effect of the modes of failure. It is usually performed by Reliability to identify critical single failure points (CSFP's) in hardware. In relation to formal hazards analyses, FMEA is a subsidiary analysis.

FAILURE RATE — Number of failures per unit of time or other measure of opportunity for failures to occur.

FAULT DETECTION — Process that discovers or is designed to discover faults.

FAULT HAZARD ANALYSIS (FHA) — Analysis performed during design resulting in the identification, evaluation, and control of hazards resulting from piece-part or component faults.

FAILURE TOLERANCE — Built-in capability of a system to perform as intended in the presence of specified hardware or software failures.

FAULT TREE — A schematic representation, resembling an inverted tree, of possible sequential events (failures) that may proceed from discrete credible failures to a single undesired final event (failure). A fault tree is created retrogressively from the final event by deductive logic.

FAULT TREE ANALYSIS (FTA) — An analysis that begins with the definition or identification of an undesired event (failure). The fault tree is a symbolic logic diagram showing the cause-effect relationship between a top undesired event (failure) and one or more contributing causes. It is a type of logic tree that is developed by deductive logic from a top undesired event to all subevents that must occur to cause it.

FINDING — A conclusion based on facts established during the investigation by the investigating authority.

FIRMWARE — Computer programs and data loaded in a class of memory that cannot be dynamically modified by the computer during processing.

FIRST AID — Emergency care or treatment given to an ill or injured person before regular medical aid can be obtained at a medical care facility (hospital). The following procedures are generally considered first aid treatment (e.g., one-time treatment and subsequent observation of minor injuries). These injuries are not considered to be NASA Reportable Mishaps if the work-related injury does not involve loss of consciousness, restriction of work or motion, or transfer to another job:

- Application of antiseptics during first visit to medical personnel.
- Treatment of first degree burn(s).
- Application of bandage(s) during any visit to medical personnel.
- Use of elastic bandage(s) during first visit to medical personnel.
- Removal of foreign bodies not embedded in eye if only irrigation is required.
- Removal of foreign bodies from wound if procedure is not complicated and is, for example, by tweezers or other simple technique.
- Use of nonprescription medications and administration of single dose of prescription medication on first visit for minor injury or discomfort.
- Soaking therapy on initial visit to medical personnel or removal of bandages by soaking.
- Application of hot or cold compress(es) during first visit to medical personnel.

- Application of ointments to abrasions to prevent drying or cracking.
- Use of heat therapy during first visit to medical personnel.
- Negative x-ray diagnosis.
- Observation of injury during visit to medical personnel.

FLIGHT HARDWARE — Hardware designed and fabricated for ultimate use in a vehicle intended to fly.

FRACTURE MECHANICS — Engineering methods used to predict flaw-growth and fracture behavior of materials and structures containing cracks or crack-like flaws.

GROUND SUPPORT EQUIPMENT — Ground-based equipment used to store, transport, handle, test, check out, service, and control aircraft, launch vehicles, spacecraft, or payloads.

HANDLERS OF HAZARDOUS MATERIAL — Individuals who handle but who do not open or otherwise disturb the integrity of the basic, properly packaged, shipping container that holds the hazardous material. As an example, this includes personnel who prepare, package, mark, or transport hazardous material. Personnel who reduce palletized or otherwise combined items into smaller increments, without exposing the hazardous material, are considered handlers.

HAZARD — Existing or potential condition that can result in or contribute to a mishap.

HAZARD ANALYSIS — Identification and evaluation of existing and potential hazards and the recommended mitigation for the hazard sources found.

HAZARD ANALYSIS REPORT — System safety document that summarizes results of the hazard analyses performed on a system or activity.

HAZARD CONTROL — Means of reducing the risk of exposure to a hazard.

HAZARD LIST — Listing of all identifiable and known hazards.

HAZARD PRIORITIZATION — A step in risk management. A ranking of hazards in order of risk severity by program and safety management for formal action to reduce the level of risk.

HAZARD PROBABILITY — Likelihood of occurrence, stated in qualitative or quantitative terms, of the aggregate of conditions that result in a specific hazard.

HAZARD REPORT (HR) CLOSURE CLASSIFICATION — Report closures are classified as eliminated hazard, controlled hazard, or accepted risk hazard. An HR when

closed will have one of the following classifications: ELIMINATED HAZARD, CONTROLLED HAZARD, or ACCEPTED RISK.

HAZARD REPORT (HR) STATUS — Report status is cited as follows:

1. CLOSED — Corrective action to eliminate or control the hazard has been implemented, or scheduled for implementation before the effectivity identified in the HR; or

2. OPEN — A HR status is open when corrective action to eliminate or control the hazard has not been completed and the corrective action is not scheduled to be performed.

HAZARDOUS EVENT — Event that contributes to a hazard.

HAZARDOUS MATERIAL — Defined by law as "a substance or materials in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce" (49 U.S.C. 1802). The Secretary of Transportation has developed a list of materials that are hazardous which may be found in 49 CFR 172.101. Typical hazardous materials are those that may be highly reactive, poisonous, explosive, flammable, combustible, corrosive, radioactive, produce contamination or pollution of the environment, or cause adverse health effects or unsafe conditions.

HAZARDOUS OPERATION — Any operation involving material or equipment that has a high potential to result in loss of life, serious injury to personnel, or damage to systems, equipment, or facilities.

HAZARDOUS OPERATION SAFETY CERTIFICATION — Certification required for personnel who perform those tasks that potentially have an immediate danger to the individual (death/injury to self), if not done correctly, could create a danger to other individuals in the immediate area (death or injury), and present a danger to the environment.

HIGH VALUE — Facilities/equipment valued at 1 million ($1,000,000) dollars and above.

HUMAN ENGINEERING — Area of engineering that applies scientific knowledge to the design of systems and operations to achieve effective human-system integration.

HUMAN FACTORS ENGINEERING — Area of engineering dealing with human biomedical and psychosocial characteristics. It includes, but is not limited to, principles and applications in the areas of human engineering, personnel selection, training, life-support, job performance aids, and human performance evaluation.

IMMEDIATELY REPORTABLE MISHAPS — All Type A and B mishaps and mission failures that require immediate telephonic notification to local and Headquarters safety officials.

INCIDENT — A mishap consisting of less than Type C mishap severity of injury to personnel (more than first-aid severity) and/or property damage equal to or greater than $1,000 but less than $25,000.

INDEPENDENT VERIFICATION AND VALIDATION — Test and evaluation process by a third party.

INDEPENDENT INHIBIT — An inhibit that will continue to operate independent of other design features.

INHIBIT — Design feature that prevents operation of a function.

INTEGRATED HAZARD ANALYSIS — Comprehensive evaluation of hazards, taking into account all subsystems/elements which are included in the overall system being analyzed, including the system, operational and environmental envelopes.

INTERFACE HAZARD ANALYSIS (IHA) — Evaluation of hazards which cross the interfaces between a specified set of components, elements, or subsystems.

INTERLOCK — Hardware or software function that prevents succeeding operations when specific conditions are satisfied.

LIMIT LOAD — Maximum combination of loads, which a structure is expected to experience in a specified operational environment.

MARGIN OF SAFETY — Deviation of the actual (operating) factor of safety from the specified factor of safety. Can be expressed as a magnitude or percentage relative to the specified factor of safety.

MEDICAL TREATMENT — The following procedures are generally considered medical treatment. Any work-related injury/illness for which this type of treatment was provided or should have been provided is considered a NASA Reportable Mishap:

- Treatment of infection.
- Application of antiseptics during second or subsequent visit to medical personnel.
- Treatment of second or third degree burn(s).
- Application of sutures (stitches).
- Application of butterfly adhesive dressing(s) or steri strip(s) in lieu of sutures.
- Removal of foreign bodies embedded in the eye.

- Removal of foreign bodies from wound if procedure is complicated because of depth of embedment, size or location.
- Use of prescription medications (except a single dose administered on first visit for minor injury or discomfort).
- Use of hot or cold soaking therapy during second or subsequent visit to medical personnel.
- Application of hot or cold compress(es) during second or subsequent visit to medical personnel.
- Cutting away dead skin (surgical debridement).
- Application of heat therapy during second or subsequent visit to medical personnel.
- Use of whirlpool bath therapy during second or subsequent visit to medical personnel.
- Positive x-ray diagnosis (fractures, broken bones, etc.).
- Admission to a hospital or equivalent medical facility for treatment (not merely observation).

MINOR RADIOACTIVE SOURCES — Quantities of minor radioactive sources are defined in terms of the level of review and reporting procedures required. Small quantities of radioisotopes as set forth by the four Radiotoxicity Groups and Hazard Categories which are further defined in the June 16, 1970, National Aeronautics and Space Council document, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations," for a variety of application, i.e., standards for instrumentation calibration, dial illumination, heat sources for vital equipment, etc.

MISSION CRITICAL — Item or function that must retain its operational capability for mission conduct.

MISSION FAILURE — Any mishap (event) of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives. A mishap of whatever intrinsic severity that, in the judgment of the Program Associate Administrator, in coordination with the Associate Administrator for Safety and Mission Quality, prevents the achievement of primary mission objectives as described in the Mission Operations Report or equivalent document.

MISSION SAFETY EVALUATION (MSE) REPORT — A formal report for a specified mission to document the independent safety evaluation of safety risk factors that represent a change, or potential change, to the risk baseline of the Program.

NASA CONTRACTOR MISHAP — Any Type A, Type B, or Type C Mishap, Mission Failure, or Incident that involves only NASA contractor personnel, equipment, or facilities in support of NASA operations.

NASA MISHAP — Any unplanned occurrence, event, or anomaly that meets one of the criteria of Type A, B, or C Mishap, Mission Failure, and Incident. Injury to a member of the public while on NASA facilities is also defined as a NASA mishap.

NASA REPORTABLE MISHAP — Any work-related mishap resulting in a death, permanent disability, or hospitalization of five or more persons; an occupational injury or illness which results in a lost workday case or medical treatment beyond first aid, loss of consciousness, restriction of work or motion, or transfer to another job; or damage to, or loss of, equipment or property damage equal to, or greater than, $1,000. Mission failures and close calls with potential as a Type A or B mishap are also reportable.

NASA SAFETY STANDARD (NSS) — A NASA safety document that requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide for safe employment and places of operation. The document is promulgated by the NASA Office of SMQ and implemented and enforced by the Center SRM&QA organization.

NONCRITICAL LIFTING — A lifting operation whose failure or malfunction (loss control, dropping a load, etc.) would not cause loss of life, loss of space vehicle, loss of payload, loss of mission essential hardware, or damage to flight or space hardware.

NONDESTRUCTIVE EVALUATION (NDE) — Test and inspection methods used to determine the integrity of equipment that do not involve destruction of the test object. Examples are ultrasonic, magnetic particle, eddy current, x-ray, dye penetrant, etc.

OBSERVATION — A factor, event, or circumstance deserving comment but not found to be a contributing or potential cause of the mishap being investigated.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AS RECORDABLE MISHAP — An occupational death, injury, or illness that must be recorded subject to OSHA requirements in 29 CFR Part 1960 and Part 1910.

OPERATING AND SUPPORT HAZARD ANALYSIS (O&SHA) — An analysis performed to identify hazards and recommend risk reduction alternatives in procedurally controlled activities during all phases of intended use.

OPERATING HAZARD ANALYSIS (OHA) — An analysis that examines the operator interface during system operation and maintenance actions. Because the operator actions are not defined until late in the system development program, corrective action resulting from this analysis will seldom be a design change. Determines certification and training requirements as well as safety inputs to technical manuals, warning signs, and safety placards.

OPERATIONAL SAFETY — That portion of the total NASA safety program dealing with safety of personnel and equipment during launch vehicle ground processing, normal industrial and laboratory operations, special high hazard tests and operations, aviation operations, use and handling of hazardous materials and chemicals from a safety viewpoint, and design, construction, and use of facilities.

POTENTIAL CAUSE — A factor, event, or circumstance which could have been a contributing cause of a similar mishap, but in the investigated case, causal relationship was not proven.

PRELIMINARY HAZARD ANALYSIS (PHA) — A gross study of the initial system concepts. It is used to identify all of the energy sources that constitute inherent hazards. The energy sources are examined for possible accidents in every mode of system operation. The analysis is also used to identify methods of protection against all of the accident possibilities.

PRESSURE VESSEL — Any vessel used for the storage or handling of a fluid under positive pressure. A pressure system is an assembly of components under pressure, e.g., vessels, piping, valves, relief devices, pumps, expansion joints, gages.

PRIMARY EVENT (FAULT TREE) — A fault, failure, or event that initiates, or participates in a mishap sequence.

PRIMARY CAUSE — The major anomalous event immediately preceding a mishap in the absence of which the mishap would not have occurred.

PROGRAM SAFETY REQUIREMENTS — Safety requirements officially imposed by a program.

PROOF LOAD TEST — A load test performed prior to first use, after major modification of the load path, or at other prescribed times. This test verifies material strength, construction, and workmanship and uses a load greater than the rated load.

RANGE SAFETY — Application of safety policies, principles, and techniques to ensure the control and containment of flight vehicles to preclude an impact of the vehicle or its pieces outside of predetermined boundaries from an abort which could endanger life, or cause property damage or embarrassment to the Government. Where the range has jurisdiction, pre-launch preparation is included as a safety responsibility.

RATED LOAD TEST — A load test performed at predetermined intervals with a load equal to the rated load.

REDUNDANCY — Use of more than one independent means to accomplish a given function.

RESIDUAL RISK — Risk that remains from a hazard after all mitigation and controls have been applied.

RISK — As applies to safety, exposure to the chance of injury or loss. It is a function of the possible frequency of occurrence of an undesired event, of the potential severity of resulting consequences, and of the uncertainties associated with the frequency and severity.

RISK CONTRIBUTORS LIST — List of hazards and associated severities and probabilities contributing to a risk.

RISK MANAGEMENT — Process of balancing risk with cost, schedule, and other programmatic considerations. It consists of risk identification, risk assessment, decision-making on the disposition of risk, and tracking the effectiveness of the results of the action resulting from the decision.

RISK (SAFETY) ASSESSMENT — Process of qualitative risk categorization or quantitative risk (safety) estimation, followed by the evaluation of risk significance.

SAFETY ANALYSIS — Generic term for a family of analyses, which includes but is not limited to: preliminary hazard analysis, system (subsystem) hazard analysis, operating hazard analysis, software hazard analysis, sneak circuit, and others.

SAFETY ANALYSIS REPORT (SAR) — A safety report of considerable detail prepared by the contractor detailing the safety features of a particular nuclear system or source. The SAR is submitted to the Interagency Nuclear Safety Review Panel (INSRP) for review.

SAFETY ANALYSIS SUMMARY (SAS) — A brief summary of safety considerations for minor sources; a safety report of less detail than the SAR, prepared and reviewed in the same manner as the SAR.

SAFETY ASSISTANCE VISIT — Informal on-site evaluations by specialists and safety personnel who, after making spot checks and sampling visits and holding discussions with appropriate levels of management, provide informal or formal reports to the affected organization.

SAFETY ASSURANCE — The attainment of acceptable risk for the safety of personnel, equipment, facilities, and the public during and from the performance of operations.

SAFETY CRITICAL — Term describing any condition, event, operation, process, equipment, or system that could lead to severe injury or major damage if performed or built improperly.

SAFETY CRITICAL FUNCTION—A system, equipment, or facility function that, by not performing as intended, causes a safety-critical condition.

SAFETY CRITICAL (CONDITION) HAZARD — A hazardous condition that may lead to loss of life, severe injury, or major property damage.

SAFETY CRITICAL ITEM — Single failure point or other element or item in a life or mission-essential application that, as determined by the results of failure modes and effects analysis or other safety analysis, is essential to the safe functioning of a system or subsystem.

SAFETY DEVICE — A device that is part of a system, subsystem, or equipment that will reduce or make controllable hazards which cannot be otherwise eliminated through design selection.

SAFETY EVALUATION REPORT (SER) — A safety report prepared by the INSRP detailing the safety of a particular source or system based on their own assessment of the contractor-supplied SAR, SAS, and other data.

SAFETY MANAGEMENT PLAN (SMP) — A document developed for a program or project to be the vehicle for safety task planning. Included in the SMP will be detailed task requirements for the system safety task tailored for the specific program/project, the program organization, safety relationships and responsibilities, task reporting channels, the required hazard analysis methodologies, and the program/project milestones.

SAFETY MARGIN — Difference between as-built factor of safety and the ratio of actual operating conditions to the maximum operating conditions specified during design.

SAFETY OVERSIGHT — Maintaining functional awareness of program activities on a real-time basis to ensure risk acceptability.

SAFETY PROFESSIONAL — A representative of the Safety Office.

SAFETY PROGRAM — The implementation of a formal comprehensive set of safety procedures, tasks, and activities to meet safety requirements, goals, and objectives.

SAFETY PROGRAM PLAN (SPP) — A document that describes the safety assurance tasks to be implemented throughout a program/project or contract, including methods of approach, safety milestones, and assigned responsibilities for fulfilling these tasks. The SPP will explain in detail how the requirements of the Safety Management Plan and the NASA FAR Supplement will be implemented.

SAFING — Sequence of events necessary to reconfigure a system to a lower level of risk.

SENIOR SAFETY STEERING COMMITTEE (SSSC) — The SSSC comprises senior Field Installation safety management personnel and personnel from the NASA Safety and Risk Management Division, Space Station Program, and Headquarters Personnel Branch. The SSSC will provide a forum to address and investigate system and industrial safety issues that cannot be resolved at the local safety levels and to facilitate appropriate resolutions NASA-wide.

SEVERITY LEVEL — An assessment of the most severe effects(s) of a hazard. Severity level will be categorized as CATASTROPHIC, CRITICAL, or MARGINAL.

SINGLE FAILURE POINT — An independent element of a system (hardware, software or human) the failure of which would result in loss of objectives, hardware, or crew.

SNEAK CIRCUIT — Unintended system design condition in electrical circuits or software source code not caused by a failure, which can inhibit wanted functions or cause unintended functions to occur through a stimulus, path, or a response relationship.

SNEAK CIRCUIT ANALYSIS (SCA) — A technique by which the system safety engineer can identify latent conditions (e.g., electrical, hydraulic, or other control systems) not caused by component failure that can inhibit desired functions or cause undesired functions to occur.

SOFTWARE HAZARD ANALYSIS — Identification and verification of adequate software controls and inhibits; and the identification, analysis, and elimination of discrepancies relating to safety-critical command and control functions.

SOFTWARE SAFETY CRITICAL — Software operations that, if not performed, performed out of sequence, or performed incorrectly, could directly or indirectly cause or allow a hazardous condition to exist.

SYSTEM CONCEPT REVIEW (SCR) — A review conducted when sufficient system functional requirements have been established. Safety verifies the adequacy of the system requirements definitions, ensures designers are acquainted with interface technical requirements, reviews design approaches to be optimized and complete, and evaluates system interfaces for risks.

SYSTEM SAFETY — Application of engineering and management principles, criteria, and techniques to optimize safety and reduce risks within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle.

SYSTEM SAFETY MANAGER (SSM) — A designated management person who, qualified by training and/or experience, is responsible to ensure accomplishment of system safety tasks.

SYSTEM SAFETY REVIEW PANEL (SSRP) — An independent panel chartered by the Program Manager to enhance the safety of the program through the ongoing conduct of independent, peer safety reviews at appropriate Program milestones, and ad hoc reviews as necessary. The size and composition of the panel shall be determined by the size, type, and safety risk potential of the Program and shall be chaired by a safety professional who is not assigned to the Program.

TYPE A MISHAP — A mishap causing death and/or damage to equipment or property equal to or greater than $1,000,000. Mishaps resulting in damage to aircraft or space hardware, i.e., flight and ground support hardware, meeting this criterion are included.

A Type A mishap also includes a test failure if the damage was unexpected or unanticipated or if the damage is likely to have significant program impact or visibility.

TYPE B MISHAP — A mishap resulting in permanent disability to one or more persons, hospitalization (for other than observation) of five or more persons, and/or damage to equipment or property equal to or greater than $250,000 but less than $1,000,000. Mishaps resulting in damage to aircraft or space hardware that meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

TYPE C MISHAP — A mishap resulting in damage to equipment or property equal to or greater than $25,000 but less than $250,000, and/or causing occupational injury or illness that results in a lost workday case. Mishaps resulting in damage to aircraft or space hardware that meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

USERS OF HAZARDOUS MATERIAL — Users are those personnel who open the incremental hazardous material shipping container, thereby exposing the material, to mix, transfer, burn, freeze, pour, vent, react, dispose, or otherwise use or alter the material.

VACUUM SYSTEM — An assembly of components under vacuum, including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc.

VACUUM VESSEL — A vessel in which the internal pressure has been reduced to a level less than that of the surrounding atmosphere.

VALIDATION — (1) An evaluation technique to support or corroborate safety requirements to ensure necessary functions are complete and traceable; or (2) The process of evaluating software at the end of the software development process to ensure compliance with software requirements.

VARIANCE — Documented and approved permission to perform some act contrary to established requirements.

VERIFICATION (Software) — (1) The process of determining whether the products of a given phase of the software development cycle fulfill the requirements established during the previous phase (see also validation); or (2) Formal proof of program correctness; or (3) The act of reviewing, inspecting, testing, checking, auditing, or otherwise establishing and documenting whether items, processes, services, or documents conform to specified requirements.

WAIVER — A variance that authorizes departure from a particular safety requirement where an increased level of risk has been accepted.

This page intentionally left blank.

APPENDIX P

ACRONYM AND ABBREVIATION LIST

A-E	Architect-Engineering
AA	Associate Administrator
ACGIH	American Conference of Governmental Industrial Hygienists, Inc.
ADTC	Armament Development Test Center
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFOSH	Air Force Occupational Safety and Health
AHJ	Authority Having Jurisdiction
ALARA	As Low As Reasonably Achievable
ALSE	Aviation Life Support Equipment
AMO	Aircraft Management Office
ANSI	American National Standards Institute
ARAR	Accident Risk Assessment Report
ARC	Ames Research Center
ASAP	Aerospace Safety Advisory Panel
ASME	American Society of Mechanical Engineers
ASO	Aviation Safety Officer
ASRS	Aviation Safety Reporting System
ASTM	American Society for Testing and Materials
CAS	Contract Administration Services
CCB	Configuration Control Board
CDR	Critical Design Review
CFR	Code of Federal Regulations
	Crash, Fire, Rescue
CI	Configuration Item
CIL	Critical Items List
CMAA	Crane Manufacturers Association of America
CoDR	Concept Design Review
CoF	Construction of Facilities
COTR	Contracting Officer's Technical Representative
CPR	Cardiac Pulmonary Resuscitation
CSFP	Critical Single Failure Point
CSC	Critical Software Command
DASHO	Designated Agency Safety and Health Official
DCMC	Defense Contract Management Command
DCN	Document Control Number
DCR	Design Certification Review
DLA	Defense Logistics Agency
DLAM	Defense Logistics Agency Manual
DoD	Department of Defense

DOE	Department of Energy
DoL	Department of Labor
DOT	Department of Transportation
DR	Design Review
DRD	Data Requirement Description
EA	Environmental Assessment
EIS	Environmental Impact Statement
ELV	Expendable Launch Vehicle
EM	Engineering Memorandum
	Electronic Mail
	Exception Monitor
EO	Executive Order
EPA	Environmental Protection Agency
ESD	Electrostatic Discharge
ESMC	Eastern Space and Missile Center
ESMCR	Eastern Space and Missile Center Regulation
ETA	Event Tree Analysis
ETR	Eastern Test Range
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FDA	Food and Drug Administration
FHA	Fault Hazard Analysis
FI	Final Inspection
FM	Factory Mutual
FMEA	Failure Modes and Effects Analysis
FOD	Foreign Object Damage
FONSI	Finding of No Significant Impact
FPM	Facility Project Manager
FRR	Flight Readiness Review
FSAR	Final Safety Analysis Report
FTA	Fault Tree Analysis
FTR	Flight Test Requirement
GAO	General Accounting Office
GFE	Government Furnished Equipment
GFF	Government Furnished Facilities
GFP	Government Furnished Property
GHB	Goddard Handbook
GIDEP	Government-Industry Data Exchange Program
GSA	General Services Administration
GSE	Government Supplied Equipment
	Ground Servicing/Support Equipment
GSFC	Goddard Space Flight Center

HLTR	Hazard List Tracking Record
HOP	Hazardous Operating Procedure
HR	Hazard Report
IAOP	Intercenter Aircraft Operations Panel
ICAP	Interagency Committee for Aviation Policy
IHA	Integrated Hazard Analysis Interface Hazard Analysis
INSRP	Interagency Nuclear Safety Review Panel
IST	Initial System Test
ISTHA	Initial System Test Hazard Analysis
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KHB	Kennedy Handbook
KSC	Kennedy Space Center
LaRC	Langley Research Center
LED	Light Emitting Diode
LeRC	Lewis Research Center
LLIS	Lessons Learned Information System
MR/CAS	Mishap Reporting/Corrective Action System
MSDS	Material Safety Data Sheet
MSE	Mission Safety Evaluation
MR	Mishap Report
MSPSP	Missile System Prelaunch Safety Package
NASA	National Aeronautics and Space Administration
NASC	National Aeronautics and Space Council
NDE	Nondestructive Evaluation
NEC	National Electric Code
NEPA	National Environmental Policy Act
NF	NASA Form
NFPA	National Fire Protection Association
NFS	NASA FAR Supplement
NHB	NASA Handbook
NHS	NASA Health Standard
NIOSH	National Institute of Occupational Safety and Health
NMI	NASA Management Instruction
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NRC	Nuclear Regulatory Commission
NSIS	NASA Safety Information System
NSRS	NASA Safety Reporting System
NSS	NASA Safety Standard

O&E	Operations and Engineering
O&SHA	Operating and Support Hazard Analysis
OHA	Operating Hazard Analysis
OHO	Occupational Health Office
OIC	Official-in-Charge
OMB	Office of Management and Budget
OP	Occupancy Permit
	Operating Procedure
ORI	Operational Readiness Inspection
ORR	Operational Readiness Review
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OSMQ	Office of Safety and Mission Quality
OSTP	Office of Science and Technology Policy
PAO	Public Affairs Officer
PAR	Pre-Advertisement Review
PAR-P	Problem Assessment Review - Payloads
PDR	Preliminary Design Review
PER	Preliminary Engineering Report
PFI	Pre-Final Inspection
PHA	Preliminary Hazard Analysis
PIC	Pilot-in-Command
PL	Public Law
PM	Program Manager
PS	Pressurized System
PSAR	Preliminary Safety Analysis Report
psig	Per square inch gage
PSSP	Project System Safety Panel
PV	Pressurized Vessel
R&D	Research and Development
RAC	Risk Assessment Code
RFP	Request for Proposal
RSO	Range Safety Office
SAR	Safety Assessment Report
	Safety Analysis Report
SAS	Safety Analysis Summary
SCA	Sneak Circuit Analysis
SCAPE	Self-Contained Atmospheric Protective Ensemble
SCBA	Self-Contained Breathing Apparatus
SCR	System Concept Review
SCUBA	Self-Contained Underwater Breathing Apparatus
SEB	Source Evaluation Board
SER	Safety Evaluation Report
SHA	System Hazard Analysis

SIP	Standardization Instructor Pilot
SMA	Safety and Mission Assurance
SMP	Safety Management Plan
SOW	Statement of Work
SPP	Safety Program Plan
SR&QA	Safety, Reliability and Quality Assurance
SRM&QA	Safety, Reliability, Maintainability, and Quality Assurance
SSB	Source Selection Board
SSC	Stennis Space Center
SSHA	Subsystem Hazard Analysis
SSM	System Safety Manager
SSP	Space Shuttle Program
SSPP	System Safety Program Plan
SSRP	System Safety Review Panel
SSSC	Senior Safety Steering Committee
	System Safety Steering Committee
STS	Space Transportation System
SWHA	Software Hazard Analysis
TLV	Threshold Limit Value
TMIG	Telemetry Inertial Guidance
TP	Test Procedure
TRR	Test Readiness Review
UL	Underwriter Laboratories
USAR	Updated Safety Analysis Report
USFA	United States Fire Administration
V	Volt
WFF	Wallops Flight Facility
WSMCR	Western Space and Missile Center Regulation
WSMR	White Sands Missile Range
WTR	Western Test Range
WX	Weather

This page intentionally left blank.